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STUDIES IN THE APOCYNACEAE. I¹

A CRITICAL STUDY OF THE APOCYNOIDAE

(WITH SPECIAL REFERENCE TO THE GENUS APOCYNUM)

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1. THE STATUS OF THE APOCYNOIDAE

INTRODUCTION

Somewhat less than four years ago, when the writer commenced a revision of the genus *Apocynum*, the possibility of further studies in the family Apocynaceae was reserved for the future. However, it soon became apparent, as the study progressed, that the problem was so complicated and had been neglected so long that it could be dealt with satisfactorily only in intimate conjunction with a thorough investigation and readjustment of the entire family. The situation was complicated, moreover, not only with numerous Apocynaceae, but with Asclepiadaceae as well.

A glance at the synonymy of *Apocynum*, for instance, will show that that genus alone has been entangled with no less than thirteen genera of Apocynaceae, and, even more surprising, twenty-two genera of Asclepiadaceae. Observation of other genera of Apocynaceae has shown that the situation of *Apocynum* is representative of the group as a whole. With such conspicuous need of an extensive revision, the present study has been prepared as the forerunner of a group of similar papers which will be concerned with the comparative morphology, taxonomy, distribution, and system of Apocynaceae, and, it is hoped, later of Asclepiadaceae as well.

SYSTEMATIC HISTORY OF THE APOCYNACEAE

Previous to Tournefort, practically all of the plants then known which are now distributed between the families Apocynaceae and Asclepiadaceae were included in one monstrous group *Apocynum*, a Latinized form of a name of Dioscorides, 'Απόκυνον, applied to a plant of Greece used as a poison for wild dogs and other animal pests. This plant, according to Dioscorides, was distinguished above all by its milky juice, and consequently any plant which happened to yield latex was apt to be named *Apocynum*,

first by the followers of Pliny, who evidently deserves credit for the composition of the name, and later by the disciples of the revered physician Galen. One generic name, therefore, characterized multitudes of pre-Tournefortian polynomials applied to milk-yielding plants which were indiscriminately Euphorbiaceae, Asclepiadaceae, or Apocynaceae.

By the time of Tournefort, students of botany had become sufficiently keen-sighted to eliminate the various Euphorbiaceae (chiefly species of *Euphorbia*) from the *melée* which was the genus *Apocynum*, but most of the genera then known, which are now understood to be Apocynaceae or Asclepiadaceae, were yet included under that single name.

The generic splitting of *Apocynum* began with Tournefort,² who recognized three generic entities in the old group. These genera, *Apocynum*, *Periploca*, and *Asclepias*, were deftly distinguished both verbally and pictorially and heralded the distinction of the families Apocynaceae and Asclepiadaceae which was to be made by Robert Brown over one hundred years later after the prestige of the artificial system of Linnaeus had been overthrown by Jussieu and his contemporary naturalists. Seven other genera now placed among the Apocynaceae were also recognized by Tournefort, which, however, were not understood by him to have any direct affinity with *Apocynum*. These genera are *Rauvolfia*, *Cerbera*, *Vinca*, *Nerium*, *Plumeria*, *Cameraria* and *Tabernaemontana*.

The sexual system of Linnaeus proved artificial indeed in the manner with which it treated the genera of Apocynaceae and Asclepiadaceae. The 'Genera Plantarum'³ split the aggregate of the two families between the "pentandria monogynia," including the genera *Rauvolfia*, *Cerbera*, *Vinca*, *Nerium*, *Plumeria*, *Cameraria*, and *Tabernaemontana* of Apocynaceae and *Ceropogia* of Asclepiadaceae, and the "pentandria digynia," including the genera *Periploca*, *Cynanchum*, *Asclepias*, and *Stapelia* of Asclepiadaceae and the genus *Apocynum* of Apocynaceae.

The natural system of Jussieu⁴ proved its worth by the man-

² Tourn. Inst. ed. 2, 2: 91-94. 1700.

³ Linnaeus, Gen. Pl. ed. 5, 98-102. 1754.

⁴ Juss. Gen. Pl. 143-151. 1789.

ner in which the Apocynaceous and Asclepiadaceous genera were treated. Those present families were combined in the class Apocineae, and were divided into three unnamed divisions upon fruiting characters. The first division embraced genera producing a pair of follicles separating at maturity, the seeds naked; the second, genera with two distinct follicles and comose seeds; and the third, genera with follicles united at maturity in the form of a berry or drupe. Appended to those three divisions was a fourth, consisting of several anomalous genera demonstrating an affinity with the Apocineae proper, but without latex. Those genera were *Strychnos*, *Theophrastia*, *Anasser*, *Fagraea*, and *Gelsemium*, all of which are extraneous to either Apocynaceae or Asclepiadaceae as at present understood.

The sagacity of Robert Brown in his separation of the Asclepiadaceae from the Apocynaceae can scarcely be overrated. In his two classic papers 'On the Asclepiadeae'⁸ and 'On the Apocineae'⁹ which were read before the Wernerian Society, November 4, 1809, the individuality of the two great natural groups for the first time became apparent. The latter paper moreover especially concerns us as a most excellent and acute appraisal of the genera of Apocynaceae then recognized. One error, however, was the inclusion of the Asclepiad *Cryptolepis* with the Apocineae.

The name "Apocynaceae" was first applied to that family by Lindley¹⁰ in 1836. The group of Lindley was practically identical with the "Apocineae" as defined by Brown, by whom it was clearly influenced to no small degree since several paragraphs of the latter's address before the Wernerian Society^{8, 9} were quoted verbatim by the former. In his synopsis of the genera of Apocynaceae, Lindley employed the subdivisions of Bartling,¹⁰ who recognized within the family three divisions, namely: *Echitea*, genera with distinct, capsular, polyspermous follicles and seeds with little albumen; *Carisseae*, genera with follicles connivent at maturity into a polyspermous berry and seeds with copious albu-

⁸ R. Br. Mem. Wern. Soc. 1: 12-58. 1809.

⁹ I. c. 59-78. 1809.

¹⁰ Lindl. Nat. Syst. ed. 2. 299-304. 1836.

⁸ R. Br. Mem. Wern. Soc. 1: 12-58. 1809.

⁹ I. c. 59-78. 1809.

¹⁰ Bartl. Ord. Nat. Pl. 203-205. 1830.

men; and *Rauwolfia*, genera with follicles connivent into a bi- or mono-spermous drupe at maturity and seeds with little albumen.

The system of Endlicher¹¹ divided the Apocynaceae into three tribes and four subtribes. These divisions were enunciated as follows: *Carisseae*: ovary simple, bilocular or unilocular, fruit baccate, or rarely capsular; *Ophioxyleae*: ovary double, fruit drupaceous; and *Euapocynae*: ovary double, fruit bifollicular, occasionally pulpy. Under the last tribe, there were four subtribes as follows: *Plumerieae*: seeds ecomose, peltate; *Alstonieae*: seeds peltate, ciliate-comose; *Echiteae*: seeds basally comose; and *Wrightieae*: seeds apically comose. This system was accepted by Spach¹² and others.

Alphonse de Candolle¹³, in accepting Lindley's family Apocynaceae, redistributed the genera into original tribes much resembling those into which they are at present found. The family as a whole was defined almost exactly as Brown had outlined it in 1809. The seven tribes recognized by de Candolle are as follows: Tribe I. *Willughbeiae*: ovary simple, unilocular, two placentae, ovules amphitropous, seeds naked, calyx eglandular; Tribe II. *Carisseae*: ovary simple, ovules amphitropous, fruit a drupe or a berry, seeds naked, calyx eglandular; Tribe III. *Plumerieae*: ovary double, ovules amphitropous, fruit a drupe, a berry, or a true follicle, seeds naked; Tribe IV. *Parsonsieae*: ovary single, bilocular, seeds apically comose, cotyledons convolute; Tribe V. *Wrightieae*: ovary double, ovules amphitropous, follicles two, seeds basally comose; Tribe VI. *Alstonieae*: ovary double, ovules amphitropous, follicles two, seeds comose throughout; Tribe VII. *Echiteae*: ovary double, ovules amphitropous or occasionally anatropous, follicles two, seeds apically comose.

Mueller¹⁴ in 1860 divided the family into six tribes: Tribe I. *Allamandeae*: anthers completely fertile, ovary single and unilocular, fruit a capsule or a drupe; Tribe II. *Carisseae*: anthers completely fertile, ovary single, uni- or bi-locular, fruit a berry or a drupe; Tribe III. *Ophioxyleae*: anthers completely fertile,

¹¹ Endl. Gen. Pl. 577-586. 1836-1840 (1841).

¹² Spach, Hist. Nat. Vég. 8: 499-503. 1839.

¹³ A. DC. in DC. Prodr. 8: 317-489. 1844.

¹⁴ Muell.-Arg. in Mart. Fl. Bras. 6: 6-7. 1860.

ovary double, fruit drupaceous; Tribe IV. *Plumerieae*: anthers completely fertile, ovary double, fruit follicular; Tribe V. *Malouetiaeae*: anthers fertile only towards the apex, seeds comose over the entire surface; Tribe VI. *Echitiaeae*: anthers fertile only towards the apex, seeds apically comose.

In 1876 the tribes of Apocynaceae were reduced by Bentham¹⁵ to three: *Carisseae*: including de Candolle's tribes I and II; *Plumerieae*, including de Candolle's tribes III and VI; and *Echitiaeae*, corresponding to de Candolle's tribes IV, V, and VII. Miers,¹⁶ in 1878, divided the family into an extremely elaborate system, but one that appears highly artificial and ambiguous:

"Class I. HAPLANTHERAE: stamens each with two anther-cells, parallel, adnate, or often dorsally attached to a soft connective.

"A. Ovule and seed anatropous.

"Tribe 1. *Ophioxyleae*: fruit drupiform and indehiscent, either single or double; cells monospermous

"B. Ovule and seed heterotropous, when the hilum is on the middle of one of the faces, equidistant from the radicular and cotyledonary extremities.

"Tribe 2. *Carisseae*: fruit drupaceous, indehiscent, 2-locular, or 1-celled by abortion: seeds imbedded in pulp, embryo straight, in albumen.

"Tribe 3. *Willughbeiaeae*: fruit drupaceous, indehiscent, 1-2-celled; seeds compressed, imbedded in pulp; embryo straight, without albumen thus differing from the preceding in the absence of albumen.

"Tribe 4. *Thevetiaeae*: 1 or 2 indehiscent drupes, 1- or 2-celled, cells or pseudo-cells monospermous; seeds without pulp, oval, fleshy, peltately affixed, exaluminous; embryo with a short radicle.

"Tribe 5. *Hunteriaeae*: 1 to 5 oval dry indehiscent drupes, monospermous: seed compressed, without pulp, laterally attached by a central hilum; embryo in copious albumen, with a superior radicle.

"Tribe 6. *Aspidospermeae*: 2 follicles, rarely combined into a 2-locular fruit, or generally only 1 by abortion seeds large, parallelly adjacent, extremely compressed, broadly winged all round a central embryoniferous scutcheon

"Tribe 7. *Allamandeae*: a single orbicular subcompressed dry capsule, unilocular seeds not very numerous; testa oval, with a broad thick callous margin (instead of a wing) surrounding a flat embryoniferous scutcheon

"Tribe 8. *Plumeriaeae*: 2 large, divaricated, thick, linear-oblong follicles, opening along their ventral suture, which expands internally into 2 flat septiform placentae: seeds many, sub-compressed, furnished below with a lacerated wing, and affixed peltately and imbricately upon each semiseptum

"Tribe 9. *Alyziaeae*: 2 lomentaceous flat indehiscent follicles, transversely articulated into several dry, monospermous cells

¹⁵ Benth. in Benth. & Hook. Gen. Pl. 2: 681-728. 1876.

¹⁶ Miers, Apoc. S. Am. 6-10. 1878.

"Tribe 10. *Craspidoaspermeae*: an elongated subcompressed, 2-locular capsule, resolvable into 2 follicles by the splitting of its bilamellar dissepiment . . .

"Class II. *SYMPHYANTHREAE*: stamens connivent, each with 2 parallel anther-cells introrsely fixed upon a much longer horny connective, usually membranaceous or cuspidate at the apex, and terminating below in 2 longer or shorter forks, the pollen-cells adhering to the clavuncle of the style, all thus held together in a cone.

"Tribe 11. *Tabernaemontaneae*: 2 follicles, ovoid or oblong, often pointed, dehiscing along their ventral suture, whose introflexed margins are seminiferous . . .

"Tribe 12. *Malouetiae*: 2 follicles, linear, oblong, or terete, dehiscing along their ventral suture, the margins of which are thickened introrsely into a solid, resilient placenta, seminigerous on both sides . . .

"C. Seeds anatropous without an apical coma.

"Tribe 13. *Robbieae*: 2 long follicles dehiscing along their ventral suture, the margins of which expand internally into 2 septiform membranaceous placentae bearing many imbricated seeds, which are oblong, . . . generally clothed with many long, soft hairs . . .

"Tribe 14. *Odontadeniaeae*: 2 elongated follicles (or 1 by abortion) dehiscing along their ventral suture, the margins of which are invariably expanded into 2 broad septiform placentae . . . ; seed long, terete, erect, narrow at its two extremities, everywhere bare . . .

"D. Seeds anatropous with an apical coma.

"Class III. *ECHITEAE*: seeds linear oblong compressed or terete, often with an elongated rostrum terminated by the micropyle, which is surrounded by a cup-shaped ring, bearing a crown of 1 or 2 series of long hairs, usually called a COMA.

"Tribe 15. *Macrosiphonieae*: 2 very long subtorulose follicles, dehiscing along the ventral suture, the narrow margins of which are inflected and seminiferous . . . Low erect, or prostrate plants, with a few axillary handsome flowers, having an extremely long narrow tube with a broad rotate border.

"Tribe 16. *Stipecomeae*: 2 follicles with very thick pericarp, sometimes very long, rugous or verrucose, dehiscing along the ventral suture, either with 2 placentae conjoined by a keel attached to the suture and then detaching itself, or else narrower remaining separately attached to the suture . . .

"Tribe 17. *Wrightiaeae*: an oblong 2-celled capsule, splitting septicidally through a thick bilamellar dissepiment (becoming like 2 follicles) . . .

"Tribe 18. *Prestonieae*: an oblong 2-celled capsule, splitting septicidally, as in the preceding tribe . . . : seeds many, imbricated, oblong, furnished at the apex with a long coma, near which they are suspended . . .

"Tribe 19. *Dipladeniaeae*: 2 long terete follicles dehiscing along the ventral suture . . . The chief peculiarity consists in a disk of 2 flat opposite lobes alternating with the ovaries.

"Tribe 20. *Proechiteae*: 2 oblong or terete follicles . . . disk urceolate, entire, or more often partly cleft into 5 or 10 lobes.

"Tribe 21. *Mesechiteae*: 2 long terete or torulose follicles, dehiscing along the ventral suture . . . Corolla small, or of moderate size, with a short tube, and rotate segments simply convoluted . . ."

Asa Gray,¹⁷ in systematizing the Apocynaceae of North America in 1878, reduced the subdivisions of the family to two, namely *Plumerieae*, characterized by free stamens (unconnected with the clavuncle), the cells of the anthers polliniferous to the base; and *Echitideae*, characterized by stamens closely connivent about, and appressed to, the clavuncle or stigmatic-head; and anthers largely sterile and appendiculate, polliniferous only near the apex. In thus basing his classification, Gray plainly followed Mueller in using the stamen as the important criterion of cleavage.

In 1895 Schumann¹⁸ raised Gray's two tribes to the rank of subfamilies, calling them *Plumeroideae* and *Echitoideae* respectively, and subdivided them into tribes as follows: Subfam. I. PLUMEROIDEAE: Tribe 1. *Arduineae*: ovary syncarpous, not divided to the base; Tribe 2. *Pleiocarpeae*: ovary divided to the base, follicles more than two; Tribe 3. *Plumiereae*: ovary syncarpous, divided to the base, follicles two; Subfam. II. ECHITOIDEAE: Tribe 1. *Echitideae*: anthers inserted within the corolla-tube; Tribe 2. *Parsonsiaeae*: anthers exserted beyond the corolla-tube.

Since 1895, systematic works have dealt more generally with phylogenetic speculations among groups of families rather than with the detailed system within the individual family, and in the case of the Apocynaceae, Schumann's system has remained the most recent until the present.

This historical sketch of the system of the family Apocynaceae, although incomplete and lacking in detail, is sufficient to illustrate the statement that the problem has never been studied by a consistent monographer who was willing to give undivided attention to the group.

The work of Miers, while a careful compendium, is limited in its scope, as the title suggests, and frequently is labored and ambiguously composed. It is always lacking the proper contrast to make a monograph usable. The monograph is moreover entirely without keys, except for a key to the genera of the tribe *Tabernae-montaneae*. In careful examination of the work, one is struck with the unfortunate fact that although the author makes innumerable new combinations, species, and even genera, actually

¹⁷ A. Gray, *Syn. Fl. N. Am.* 2¹: 79-85. 1878.

¹⁸ K. Sch. in *Engl. & Prantl. Nat. Pflanzenfam.* 4¹: 109-189. 1895.

sixty per cent of the species and genera (frequently new) were known to the author only at second hand. Further reference to the work of Miers will perforce frequently be made throughout these studies.

Since the last intensive work upon the system of the Apocynaceae was published over a half century ago, it may not be surprising that further study of the group should result in an attempt to readjust its divisions. Recent studies during several years have resulted in the following new classifications of the family:

Fam. APOCYNACEAE

Lindl. Nat. Syst. ed. 2, 299. 1836; Endl. Gen. Pl. 577. 1838; A. DC. Ann. Sci. Nat. Bot. 3¹: 235. 1844; in DC. Prodr. 8: 317. 1844; Benth. in Benth. & Hook. Gen. Pl. 2: 681. 1876; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 109. 1895. *Apocineae* Juss. Gen. Pl. 143–151. 1789, *in part.*; R. Br. Mem. Wern. Soc. 1: 12–58. 1809.

Subfam. I. ECHITOIDEAE

K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 160. 1895, *in part.*

Stamens largely sterile, basally appendaged, the anthers 4-locular, connivent about the clavuncle, pollen tetrads separating into individual grains; ovary apocarpous; corolla variously appendiculate within, or naked; calyx bearing various glandular appendages within, or rarely (?) naked. Woody vines or clambering shrubs, rarely rhizomatous herbs.

Subfam. II. APOCYNODEAE, n. subfam.

Stamens largely sterile, basally appendaged, the anthers 4-locular, becoming 2-locular at maturity, connivent about the clavuncle, pollen in persistent tetrads; ovary apocarpous; corolla appendiculate within by 5 individual or coalesced flanges opposite the corolla-lobes and alternate with the stamens; calyx naked within. Rhizomatous herbs.

Subfam. III. PLUMEROIDEAE

K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 122. 1895.

Anthers completely fertile, not basally appendaged, 4-locular, free, not connivent about the clavuncle, pollen tetrads separating into individual grains; ovary apocarpous or syncarpous, bi- or occasionally uni-locular; corolla variously appendiculate within, or naked; calyx naked, or bearing various glandular appendages within. Trees, woody vines, and shrubs, rarely rhizomatous herbs.

Tribe 1. PLUMIEREAE K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4th: 122. 1895.

Ovary apocarpous, follicles two.

Subtribe A. *Tabernaemontaninae* K. Sch. l. c. 1895.

Calyx bearing numerous glandular appendages within, fruit pulpy.

Subtribe B. *Alstoniinae* K. Sch. l. c. 1895.

Calyx unappendiculate within, fruit dry.

Tribe 2. PLEIOCARPEAE K. Sch. l. c. 1895.

Ovary apocarpous, follicles more than 2.

Tribe 3. RAUWOLFIEAE, n. tribe.

Ovary syncarpous, bilocular, placentation axile.

Tribe 4. ARDUINEAE K. Sch. l. c. 1895.

Ovary syncarpous, unilocular, placentation parietal.

In the present studies, investigation was commenced about the genus *Apocynum*, so an attempt to express the natural relationship in the Apocynaceae naturally centers about Schumann's inclusive subfamily Echitoideae (including the new sub-family Apocynoideae) to which that genus pertains.

MORPHOLOGICAL AND PHYLOGENETICAL DISCUSSION

Before undertaking a discussion of the differences separating the Apocynoideae and the Echitoideae, a few words justifying the foregoing system of Apocynaceae as a whole may be *à propos*. It will quickly be perceived that the new system proposed is an almost complete reversal of Schumann's system elaborated in 'Die natürlichen Pflanzenfamilien.'

The general theme in Schumann's system is elaboration. In separating the two subfamilies Plumeroideae and Echitoideae

Schumann bears in mind the popular conception that sterilization of tissue is an "advanced" condition, and so places the divisions in the above sequence, since the former group includes genera with completely fertile anthers in contrast to the latter which includes genera with largely sterile, appendiculate anthers. Such a view is generally logical, but may be superseded by additional considerations.

With the exception of the genera of Apocyneoideae, excluded in the foregoing section, the Echitoideae as visualized by Schumann presents a group of genera which are relatively homogeneous from a morphological and phylogenetical point of view. All genera are distinctly apocarpous. All genera, with few exceptions, as *Nerium*, and with some modifications, such as coalescence (cf. *Odontadenia*, etc.) and reduction of the number of units (cf. *Dipladenia*, etc.), display a cycle of vestigial nectaries surrounding the carpels. All genera, as far as is known at the present, display the appendiculate condition of the calyx. The group as a whole is an exceedingly natural one.

Such, however, is not the case of the subfamily Plumeroideae. The phylogenetical range is wide. Some genera, it is true, are so similar to those of the Echitoideae that only the complete fertility of the anthers bars them from that classification. Such genera, of course, are apocarpous and display a squamelliferous calyx and a cycle of nectaries about the gynoecium. However, gradations appear from that condition, through degeneration of the calyx squamellae and vestigial nectaries with gradual coalescence of the apocarpous carpels, to a condition of a syncarpous (occasionally even unilocular) gynoecium and a completely naked calyx and receptacle. In some genera, as in *Stemmadenia* and *Tabernaemontana* respectively, the coalescence and subsequent disappearance of the nectaries are accomplished through adnation to the gynoecium, thereby exerting an unmistakable influence towards syncarpy¹⁰; in others the nectaries disorganize without visible trace, as in *Amsonia*. The Plumeroideae, then, are a very heterogeneous group, and one which shows the effects of evolution clearly. The tendencies manifest in it, moreover, are more

¹⁰ cf. Woodson, R. E., Jr. A revision of the genus *Stemmadenia*. *Ann. Mo. Bot. Gard.* 15: 347-349. fig. 1. 1928.

varied, and of a more "advanced" nature than those in the Echitoideae. It appears unfortunate, therefore, that Schumann considered the mere sterilization of the anthers of such importance that he was led to interpret the Plumeroideae as demonstrating a "primitive" condition.

In his tribal divisions of the Plumeroideae Schumann is rather difficult to follow. In his system lower genera have a syncarpous, unilocular ovary with two lateral parietal placentae, while more advanced genera pass through a syncarpous, bilocular stage with axile placentation to complete apocarpny. Moreover, lower genera have unappendaged, eglandular calyces, while higher genera gradually develop distinct, orderly calycine appendages. Such a system has philosophical justification, perhaps, but should be superseded by more natural considerations.

In the system which is here proposed, therefore, the order of Schumann in the Plumeroideae has been reversed, and we presume that lower, or more primitive, genera have an apocarpous ovary and progress through bilocular syncarpy with axile placentation to higher, or more advanced, genera with unilocular syncarpy and parietal placentation. An illustration of this is furnished in text-fig. 1, which presents diagrams of ovary cross-sections of three representative genera of Plumeroideae, namely, *Amsonia*, *Ambelania* and *Allamanda*. It will be seen that in *Allamanda* the irregular, binate, parietal placentations are sterile in the central region, hinting strongly that a transverse fission of the septum separating a bilocular ovary has resulted in a more or less unilocular condition. Such a view of the advanced condition of the syncarpous unilocular ovaries is strengthened by recapitulatory evidence in the very young stages where they appear as bilocular with axile placentation, much resembling the diagram of *Ambelania* in text-fig. 1. We may be fairly sure, then, that as a matter of fact the bilocular axile type is the forerunner of the unilocular parietal type.

Certain Gentianaceous ovaries, as those of *Frasera* and *Halenia*, unilocular with parietal placentation when mature, also display axile placentation when immature. Anatomically, an explanation of such a process of ovarian evolution appears relatively simple, since the "margins" of the apocarpous carpels forming the binate

axile placentations are never completely coalesced, and in microscopical preparations may be seen to be anatomically separate (cf. text-fig. 4, diagram 6, and text-fig. 7, diagrams 10-14). Therefore, in order to obtain a unilocular parietal ovary from a bilocular axile ovary, it is necessary only to project the coalescence of the carpels of the ovary and the widening of the breach between the halves of the binate axile placentae in either carpel, thus forming an unilocular parietal condition. As a matter of fact, the stages of such tendencies are frequently found in transverse sections of the ovary of *Nerium*, especially towards the apex of the ovary cavities.

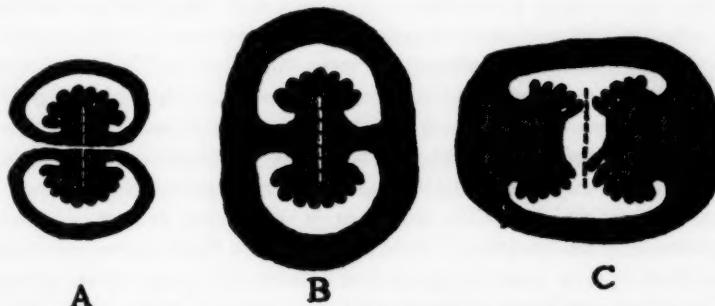


Fig. 1. Diagrammatic transverse sections of ovaries of various Plumerioideae.
A: *Amsonia ciliata*; B: *Ambelania tenuiflora*; C: *Allamanda cathartica*.

The separation of the Apocynoideae and the Echitoideae upon the basis outlined just preceding is supported by a morphological and anatomical study of the floral mechanism of those subfamilies. For this study, fresh flowering material was available only in the case of the genera *Apocynum* and *Nerium*. For an understanding of the exotic genera, herbarium specimens were employed. All material was embedded in paraffin, sectioned at 5-10 μ , and stained with anilin safranin used in combination with either *licht gruen* or gentian violet. The combination of Delafield's haematoxylin with safranin also proved very satisfactory.

Herbarium material requires special technique in order to prepare it for the microtome, and to meet that need the following procedure is followed. The specimens are carefully chosen, care being taken to detach only fragments affected at a minimum

by pressing. The fragments are placed in a vessel containing distilled water and heated to about 90°C. The material is then placed in a Stender dish containing the heated distilled water, covered and placed in an oven thermostatically heated at about 60°C. Although the time of soaking in the oven varies with the condition of the fragments, twenty-four hours is probably a minimum and a week a maximum.

After the material appears properly soaked, it is removed to a vial containing Farmer's Fluid (six parts absolute alcohol; one part glacial acetic acid). After at least twenty-four hours in that fluid, it is washed in absolute alcohol where it may be left for an additional twenty-four hours. Xylol can then be added gradually to the absolute alcohol, eventually attaining purity. The xylol is in turn gradually replaced by paraffin. It is well to leave the material in pure paraffin for some time before imbedding and sectioning,—a week proved favorable in most cases. While the schedule given above is purely tentative, and lacks refinements in many details, notably the clearing reagent employed, very satisfactory serial sections were cut of over forty genera of Apocynaceae by that method. Flowers treated in that manner proved satisfactory for morphological and anatomical study even after fifty to seventy years of desiccation.

As outlined in the preceding section, the chief characters of cleavage between the Apocynoideae and the Echitoideae are the presence or absence of calycine squamellae, and the state of the mature pollen.

A study of the pollen of the three genera of the subfamily Apocynoideae has demonstrated that the pollen of those genera always develops and matures in persistent tetrads, the grains never normally becoming separated. On the other hand, the mature pollen of the genera of Echitoideae apparently always occurs as single grains, the tetrads breaking up relatively early in the life of the anthers. These observations have been made after microscopic studies of the more important genera selected at random throughout the subfamily, including inhabitants of all the major land divisions of the earth. The Echitoideae share with the Plumerioideae the individual condition of the pollen grains at maturity.

The calyx of the Apocynoideae is naked within; while the calyx of the Echitoideae is glandular-appendiculate within, although the individual appendages, or squamellae, may be extremely reduced and inconspicuous. The squamellae are found most frequently in groups opposite the calyx-lobes. In such genera as *Prestonia* and *Echites* there may be only a single squamella for each lobe of the calyx. The genus *Cycladenia* probably exhibits the most reduced form of the calycine appendages, where they appear merely as an almost microscopic fringe. In *Prestonia*, however, they are very conspicuous, and frequently equal in size the lobes of the calyx. The squamellae are thought to be of phylogenetic interest because of their histology and teratology.

For an histological study of the squamellae of the Echitoideae, fresh material was available only for the genus *Nerium*. However, preparations were also made from herbarium specimens of *Prestonia mexicana*, *Echites umbellata*, *Echites* n. sp., *Odontadenia speciosa*, *Macrosiphonia hypoleuca*, *Mandevilla tubiflora*, *Cycladenia humilis*, *Neobracea valenzuelana*, *Elytropus chilensis*, *Wrightia tinctoria*, and *Anisolobus Andrieuxii*. Two species of *Nerium* were studied, namely, *N. odorum* and *N. Oleander*, but since they proved practically identical from an histological standpoint, at least in regard to the details under observation, only the generic name will be used when reference to either species is made.

Text-fig. 2, diagram 7, illustrates the floral diagram of *Nerium*. The flower is seen to consist of a bicarpellate center (c) surrounded by cycles of fives. Between the calyx (a) and the corolla (b) and opposite the lobes of the former are situated the squamellae (d) in groups of various numbers of individuals. Plate 2, fig. 1, represents a longitudinal section of an individual appendage subtending a lobe of the calyx. A central core (a) is composed of vertical, elongate cells which are tapered at either end, somewhat resembling vascular cells. No spirally thickened cells are discernible in the organ itself, but one is occasionally able to find immediately below it, in the thickened receptacle, traces composed of spirally thickened cells (c) leading directly to the squamella. At right angles to the central conducting core of the squamella are found horizontally compressed cells rich in cytoplasmic content, forming a conspicuous glandular tissue (b). The nuclei of

the glandular cells are found to be chiefly in the region of the proximal half near the transverse wall adjoining the "conductive" or core tissue, apparently indicating a physiological relationship between the two tissues.

Floral anatomy in recent years has endeavored more and more

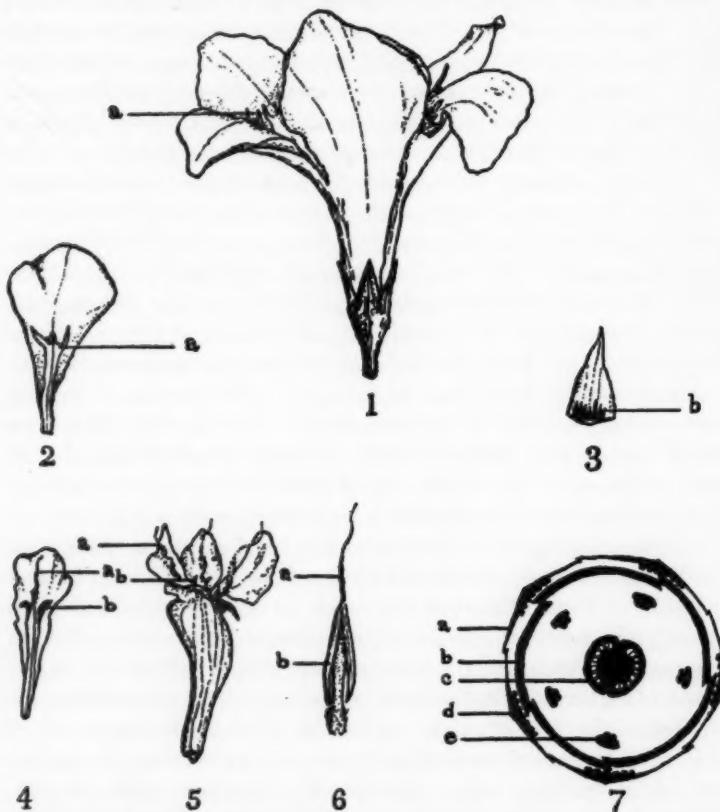


Fig. 2. The flower of *Nerium Oleander*. 1: habit; 2: ventral surface of corolla-lobe, illustrating the tridentate flange, *a*; 3: ventral surface of calyx-lobe, illustrating the calycine squamellae, *b*; 4: ventral surface of petalode, illustrating the staminal anthers, *a*, and rostrum, *b*; 5: connate mass of petalodes, illustrating the staminal anthers, *b*, and rostrum, *a*; 6: stamen, illustrating rostrum, *a*, and anthers, *b*; 7: floral diagram illustrating the position of the calyx, *a*, corolla, *b*, gynoecium, *c*, squamellae, *d*, and androecium, *e*.

to explain structures casually described by systematists, and has thus contributed greatly to phylogenetical study. The morphologist and the anatomist have frequently been aided or even inspired by teratological objects. The elder de Candolle depended frequently upon teratological observations for his morphological interpretations, and even declared that it was his belief that the morphology of *Begonia* could probably best be clarified by the appearance of a monstrosity. Robert Brown interpreted several teratological structures as reversionary, and recently the theory of "Carpel Polymorphism"²⁰ has had its inception after the appearance of teratological carpels of *Matthiola*. Generally speaking, the evolutionary theory has been immensely helped by the discovery and careful interpretation of monstrosities.

With the exception of *Vinca*, *Nerium* is probably the most widely cultivated genus of Apocynaceae. The intensive cultivation to which it has been subjected has produced several races of double-flowered forms. While the petalody is occasionally of the stamens, producing supernumerary petals within the true corolla, by far the most frequent condition is for the supernumerary petals to be produced between the true corolla and the calyx. If such a double flower is dissected it will be perceived that the supernumerary petals are of very unequal size (text-fig. 3), grading from petals equaling the lobes of the true corolla to inconspicuous and malformed filaments much smaller than the lobes of the calyx. If the calyx is examined for squamellae in such a case, it will be found that they are either absent, or extremely reduced in numbers. That the double flowers of *Nerium* are produced by petalody of the squamellae has long been appreciated and the occurrence has been called "adenopetalry" by Morren,²¹ who also noted it under somewhat similar circumstances in the flower of *Lopezia*. Among the Apocynaceae, adenopetalry has also been found to contribute to the double flower of *Tabernaemontana Coronaria*.

If the supernumerary petals of *Nerium* are examined carefully (text-fig. 3), it will be seen that they are almost exactly similar, from the largest and most perfect to the most inconspicuous and

²⁰ Saunders, E. R. Ann. Bot. 38: 451-482. 1923.

²¹ Morren, C. Bull. Acad. Roy. Sci. Belg. 17: 516-524. 1850.

malformed, to the lobes of the true corolla if those organs were polypetalous. As a matter of fact, in the double flowers the hint of reversion is frequently heightened by the partial dialysis of the gamopetalous corolla. This similarity is strikingly illustrated by the presence of the conspicuous tridentate flange which the corolla lobes bear upon their ventral surface. Similar flanges are borne upon each of the supernumerary petals except when those bodies are reduced to mere filaments, which occasionally occurs.

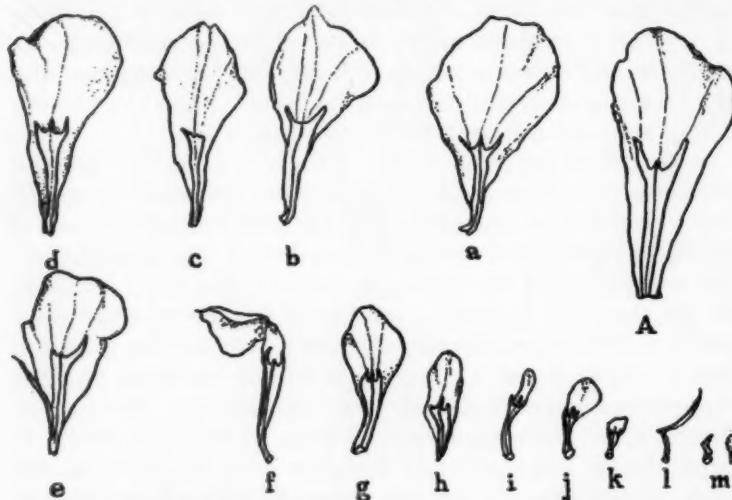


Fig. 3. Adenopetaly in *Nerium Oleander*: A, lobe of normal corolla; a-m, supernumerary petals, illustrating gradation to squamellae.

Histological preparations of the double flowers disclose the fact that the vascular traces which were seen occasionally to lead to the squamellae in the single flowers actually traverse the supernumerary petals in the double flowers. Plate 2, fig. 5, represents a cross-section of a supernumerary petal of *Nerium* illustrating the vascular system which is exactly similar in number of traces and cellular constitution to that of the corolla-lobes. Fig. 2, of plate 2, illustrates the longitudinal section of a supernumerary petal, to contrast with the longitudinal section of the squamellae in fig. 1 of the same plate. Text-fig. 2 illustrates the gross morphology of the flower of *Nerium*. Diagram 1 represents

the habit of the flower, diagram 2, the ventral surface of the corolla-lobe indicating the tridentate flange (*a*), and diagram 3, the ventral face of the calyx-lobe indicating the group of squamellae (*b*). Text-fig. 3 illustrates the stages of adenopetalry in a double flower from a normal corolla-lobe (*A*) to the smallest of the supernumerary petals (*m*).

The significance of the tridentate flange upon the ventral face of the corolla-lobes and supernumerary petals is also interpreted through teratology, it is believed. Text-fig. 2, diagram 5, illustrates petalody of the stamens of a double flower of *Nerium*. The connate stamens have in this case formed a gamopetalous pseudo-corolla composed of five petaloid stamens. If this teratological structure is dissected, it is seen that each of the five lobes (diagram 4) is composed in a manner similar to those of the corolla (diagram 2) and the supernumerary petals of the adenopetalous flowers (text-fig. 3 *a-m*). In some cases the staminode is completely sterile, while in others the ventral face of the organ bears two loculae of an anther (*b*) similar to those of a normal stamen (diagram 6), although conspicuously reduced in size. If the diagrams are examined carefully and comparatively, it will be seen that the blade of the staminodes (and consequently the corolla-lobes and the adenopetalous supernumerary petals) is equivalent to the filament and connective of the stamen (diagram 6), while the lateral and median lobes of the flange are equivalent to the anther-lobes (*b*) and the elongate rostrum (*a*) of the stamen, respectively.

Somewhat more precise information concerning the vascular relationships of the single and double flowers of the Oleander may be obtained by an examination of microscopic preparations of serial transverse sections.

Text-fig. 4 presents a series of diagrams of transverse sections of a single flower of *Nerium* to illustrate the origin of the vascular supply of the floral organs. Diagram 1 represents the vascular constitution of the pedicel just below the gradual enlargement of the receptacle. The stele is in the form of a hollow cylinder, and although circular in cross-section immediately after leaving the peduncle, it soon assumes the triangular form indicated in the diagram. Gaps are soon apparent in the triangular cylinder, as

successively higher sections are examined, and eventually the stage represented by diagram 2 is reached, where the stele is

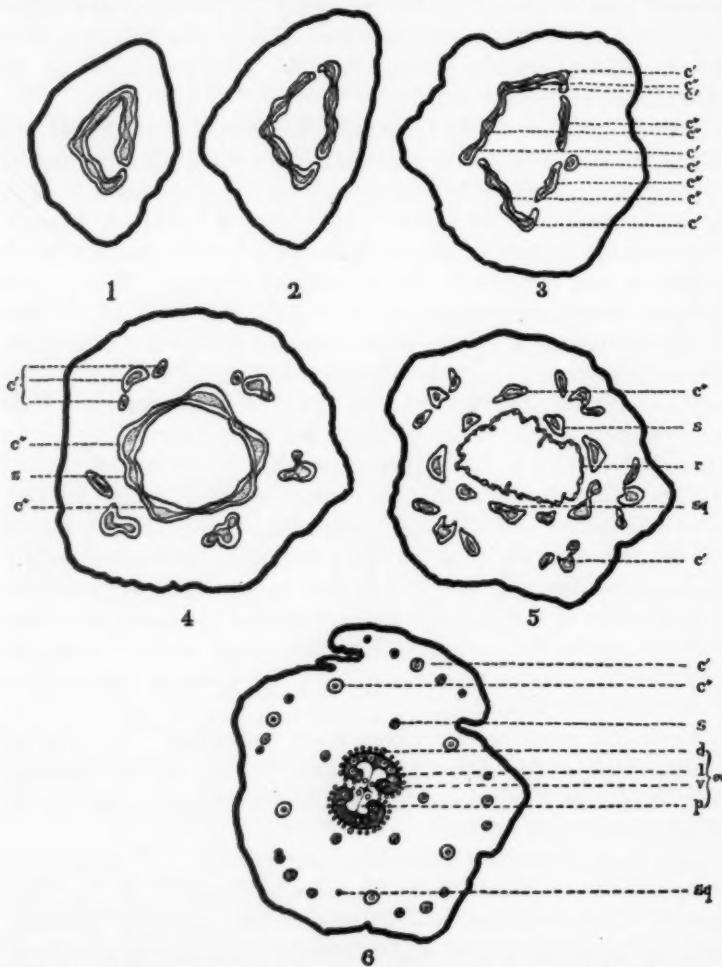


Fig. 4. Diagrammatic serial transverse sections of the receptacle of a single-flowered variety of *Nerium Oleander*. Explanation in the text.

broken in two opposite places, and is rather conspicuously and regularly lobed throughout.

When the stage represented by diagram 3 is reached, the calycine traces (c') have in all but one case partially detached themselves from the central cylinder, and the corolline traces (c'') are evident as conspicuous alternate lobes. The calycine traces almost immediately resolve into a stout dorsal trace and two finer ventral traces, evidently illustrating a case of the fusion of three traces at the place of departure from the central cylinder.

After the complete departure of the calycine traces, the isolated corolline lobes unite into a fairly well-defined five-lobed cylinder (diagram 4). This cylinder quickly becomes of relatively uniform thickness, after which, in the place of the five original lobes, *ten* lobes appear opposite and alternate with the calycine traces. These lobes eventually disengage into ten traces, five larger alternating with the calycine traces, and five smaller opposite traces. At the same time either cycle gives rise to numerous residual fragments, or bundles which remain towards the center of the axis (diagram 5). Diagram 6 illustrates the receptacle just prior to the full elaboration of the floral organs. Of the three cycles of traces other than the calycine, the five larger are found to give rise to the corolla-lobes, the five smaller to the stamen-filaments (s) which are adnate to the corolla-tube, and the numerous residual traces (r), frequently as many as forty or sixty, to the gynoecium. Although the reunited cylinder of the corolline and staminal traces regularly breaks up into ten traces, frequently extra traces originate (sq), and it is these traces (text-fig. 4, diagrams 5sq-6sq) which, in longitudinal sections, are found directly beneath the squamellar appendages (plate 2, fig. 1c). The significance of these extra traces may be appreciated from the phenomena described in the following paragraphs.

The early stages in the breaking up of the pedicellar stele are similar in both the double and the single flowers of *Nerium*. The stages diagrammed in text-fig. 4, diagrams 1-4, are almost exactly similar for both the single and the double forms. However, after the reorganization of the central cylinder after the departure of the calycine traces, the stele breaks up into a larger number of traces than was observed in the single flowers. In almost all cases, this number was twenty, in the manner indicated in text-

figure 5, diagram 4. Subsequent sections (text-fig. 5, diagrams 5-6) proved that these twenty traces were destined for two

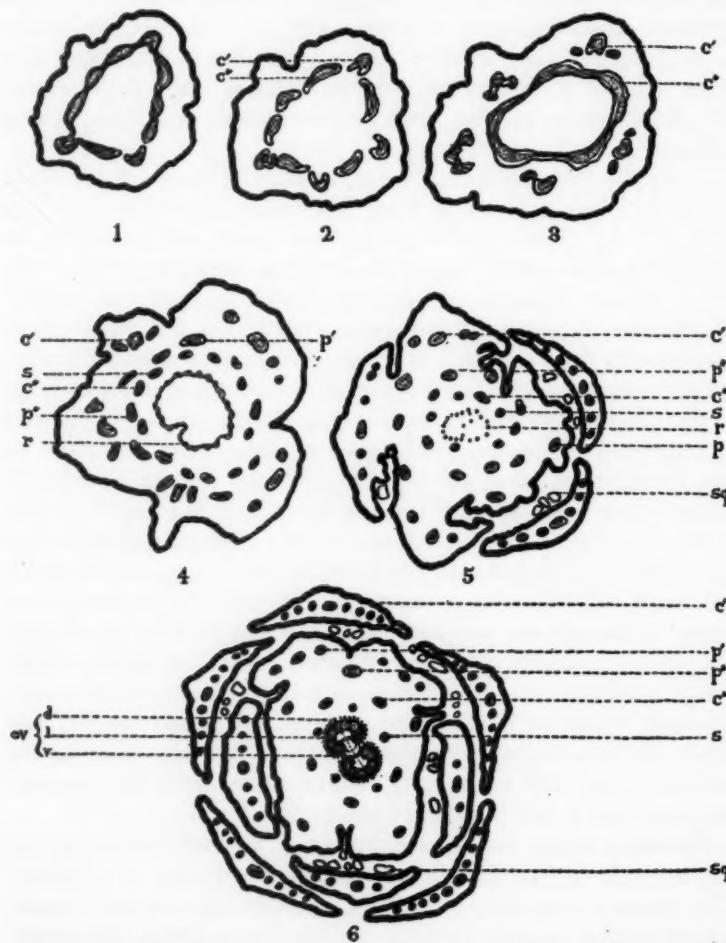


Fig. 5. Diagrammatic serial transverse sections of a double flower of *Nerium Oleander*. Explanation in the text.

cycles of exterior supernumerary petals in addition to the cycle of gamopetalous corolla and the cycle of epipetalous stamens.

The vascular traces traversing these supernumerary petals are similar to those of the true corolla in remaining unbranched until entrance into their respective organs. Both petals (including the supernumerary and the corolla-lobes) and stamen-filaments contrast with the calyx-lobes in possessing simple traces while within the receptacle.

While the supernumerary petals of *Nerium* were found in the vast majority of cases to be provided with vascular traces in the manner described in the preceding paragraphs, occasionally very reduced supernumerary petals were detected which contained no evident vascular supply. Thus in text-fig. 3, in addition to the corolla-lobe (*A*), the dissection of the particular double flower displays ten supernumerary petals supplied with conspicuous vascular traces (*a-j*) and four extremely attenuate appendages, larger than the normal squamellae, and evidently also greatly reduced supernumerary petals, but not vascularly supplied. Such extremely reduced supernumerary petals retain to a certain degree the glandular nature of the true calycine squamellae.

In view of the evidence presented, it is thought likely that in the possession of calycine squamellae the Apocynaceae, as well as certain other families of the Contortae, as the Gentianaceae, suggest a rather striking relationship with polyandrous poly-petalous families of plants. Because of the extreme variability of the reversion of these organs in teratological varieties, due no doubt to very great reduction, the exact nature of a hypothetical polyandrous type cannot be described. However, it might be supposed that (from the evidence of the two cycles of vascularly supplied supernumerary petals) such an ancestor in all probability displayed at least two additional cycles of floral organs to those which occur in the modern flower (single), and possibly two cycles besides those, evidenced by the non-vascular appendages frequently detectable.

From what has been said in the preceding paragraphs, it will be perceived that the stamens, corolla-lobes, and supernumerary petals are believed to be homologous. It is also believed that in the single flowers the supernumerary petals are represented by the squamellae. In other words, the squamellae are held to represent staminodia. The case of staminody, however, is considered

so extreme that constancy in numbers and arrangement has disappeared. The importance of the squamelliferous calyx, however tenuous the explanation, must be accounted for nevertheless because of its almost universality in the Apocynaceae and its frequency in other families of the Contortae, as in the Gentianaceae. Of course to clinch the theory that the squamellae represent staminodia it would be necessary to find, perhaps, a teratological specimen upon which the squamellae had become not only petaloid but antheriferous. However, this condition is virtually obtained by the presence of the dorsal flange, which we have seen in the foregoing paragraphs and accompanying figure to be the homologue of the anther. Reasons accounting for the presence of the "staminodial" squamellae outside the gamopetalous corolla will follow in a succeeding paragraph.

The mechanics of such centripetal sterilization as is projected to have occurred in some polyandrous form to produce a structure similar to the modern single flower of *Nerium* is evidently at work in many of the polyandrous Polypetalae of the world to-day. Such genera are *Nymphaea*, *Cactus*, *Mentzelia*, and many another, each of which displays the effects of progressive centripetal sterilization of the multiseriate androecium, from exterior completely sterile petaloid laminae to completely fertile interior stamens. The suggested explanation of the single flower of *Nerium* merely requires a continuation of sterilization in addition to the oft-invoked processes of reduction, coalescence and adnation.

An interesting and significant morphological feature which the Apocynoideae have in common with most Echitoideae is a cycle of usually five, fleshy, ovate-cylindrical nectaries surrounding the carpels (*cf.* text-fig. 10*f*). In the Apocynoideae the genera *Apocynum* and *Trachomitum* exhibit a cycle of five individual and distinct bodies, while in *Poacynum* the nectaries are more or less united into a fleshy annulus about the gynoecium.

In the Echitoideae the nectaries may be either present or absent. The genus *Nerium* is a representative of the comparatively few genera in which they are lacking. When present, the nectaries usually number five, but may be reduced to three or two, as in *Dipladenia*. Although usually individual and separate, the nectaries are sometimes coalesced into an annulus closely investing the gynoecium, as in *Odontadenia*.

Examined histologically, the nectaries provide a fascinating study. Plate 3, fig. 2, represents diagrammatically a cross-section of the flower of *Apocynum androsaemifolium*. It will be seen that the nectaries (e) form a circle about the carpels (d), alternating with the filaments of the stamens (a). According to the diagram the carpels contain three traces each, as do also the nectaries. Plate 6, fig. 2, represents in more detail a longitudinal section through a nectary of the same species of *Apocynum*. It will be seen that the vascular element is practically identical with the traces found in the gynoecium and figured in the clavuncle in fig. 3 of the same plate.

For a more detailed knowledge concerning the interpretation of the nectaries, the vascular system of the flower of *Apocynum* was studied by means of serial transverse sections in a manner similar to that by which the squamellae of *Nerium* were studied. The diagrams in text-figures 6 and 7 illustrate this phase of the investigation, being numbered consecutively throughout the two figures.

In the pedicel of a flower of *Apocynum cannabinum* the stele is at first found to form a continuous bicollateral cylinder which is nearly circular in cross-section (diagram 1). Very soon, however, the triangular cross-section noted in the pedicel of *Nerium* replaces the circular (diagram 2). Still further towards the distal end of the pedicel the stele becomes still more angled, eventually assuming the five-angled appearance illustrated in diagram 3. This stage indicates the transformation of the pedicel into the receptacle.

In diagram 4, the five angles noted in the preceding diagram have become very prominent, and alternating with them are discernible five additional, lesser lobes. In diagram 5, the condition noted in diagram 4 has almost resulted in the disruption of the stele into ten discrete segments. These consist of a series of five prominently angled sectors, identifiable as the bases of the calycine traces (c'), and a series of five alternating broader segments destined for the corolla lobes (c'').

In diagram 6, the condition in the preceding diagram has become modified by the conspicuous bilobed appearance of the five prominently angled, or calycine, lobes of the receptacular

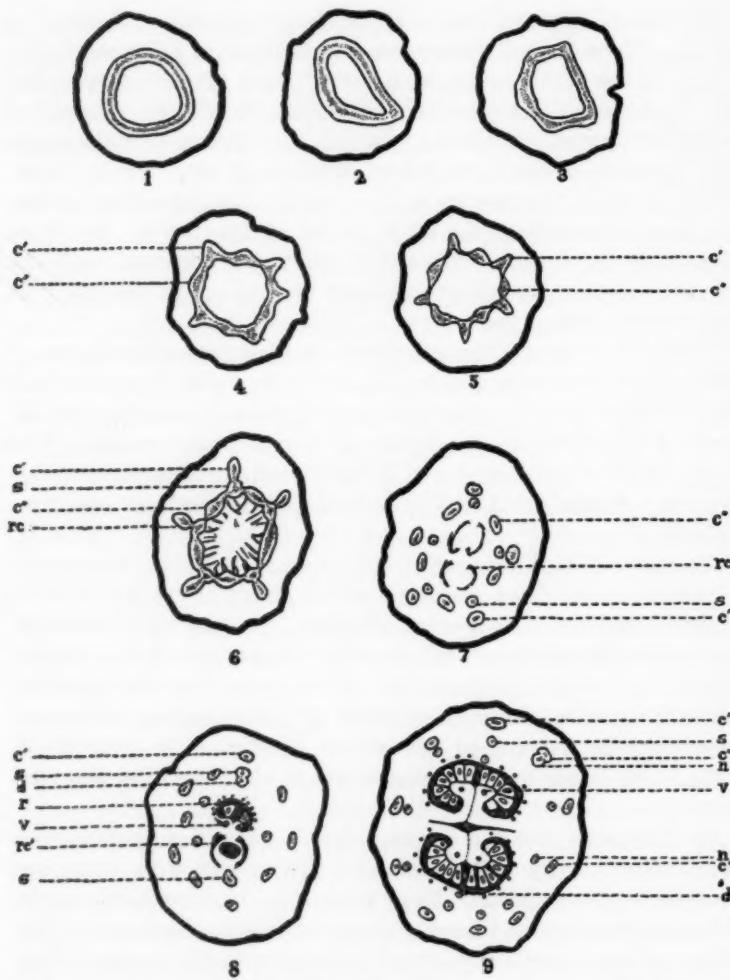


Fig. 6. Diagrammatic serial transverse sections of the flower of *Apocynum cannabinum*. Explanation in the text.

stele. As subsequent sections revealed, the dorsal lobe was destined for the calyx-lobe, whereas the ventral lobe would separate to supply the staminal filament (*s*). This condition is

evidently explained by the adnation of the calyx traces, or rather by their failure to depart promptly from the receptacular stele.

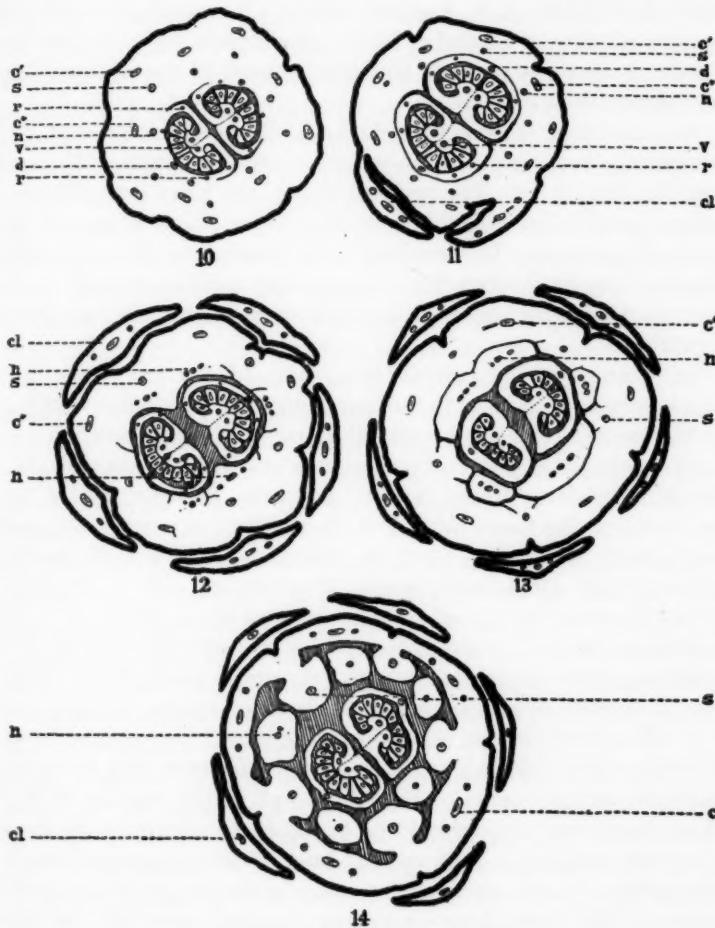


Fig. 7. Continuation of fig. 6.

This is appreciated by comparing text-fig. 6, diagram 6, with text-fig. 3, diagram 4, and text-fig. 4, diagram 3, of the genus *Nerium*, in which the calycine traces depart from the central

cylinder before the appearance of the staminal lobes. This situation, then, is an adnation of the calycine traces, rather than adnation of the staminal traces, as it might appear in longitudinal sections. In the same diagram (diagram 6), residual traces (rc) appear within the central cylinder, thus appearing in *Apocynum* at about the same stage in the development of the receptacle as was observed in *Nerium*.

In diagram 7, the central cylinder of the receptacle has at last broken up into calycine traces (c'), corolline traces (c''), and staminal traces (s). The residual traces (rc') have formed themselves into two irregular, lunate semicircles. This action of the residual traces may be visualized as a breaking up of the roughly circular form in diagram 6 (rc), and a very decided ventral development, producing the in-rolled semicircles illustrated in diagram 7 (rc').

In diagram 8, the first differentiation of the receptacle into floral organs is perceived in the appearance of the ovarian cavities. In the lower of the two cavities illustrated, the placentation has not yet formed, and the only vascular element is the semicircular formation of the residual traces. However, in the upper of the two cavities, the first evidence of placentation is perceptible, and coincidentally it is found that the vascular equipment is nearly, although not quite, completed. The ventral, or ovuliferous, traces (v) of either carpel, as may be seen from this figure, are formed by the two in-rolled margins of the residual semicircular cylinders, while the lateral veinlets (r) usually found towards the base of the carpels also arise from the residual traces. In diagram 8, it will quickly be seen that midribs, or dorsal traces, are absent from the region of the ovarian cavities. However, the staminal trace nearest the region of the dorsal wall of the ovarian cavity where the dorsal trace should be found is discovered to be conspicuously bi-lobed. The ventral lobe of this compound trace eventually proves to be the dorsal trace of the carpel (d), which is adnate to the dorsal lobe, or proper staminal trace (s). In the upper ovarian cavity illustrated in diagram 8, the lobing of the compound staminal-carpellary trace is almost complete, while in the lower cavity the lobing has just begun to be noticeable.

In diagram 9, the elaboration of the ovarian cavities is completed.

The vascular constitution of either carpel is seen to consist of a dorsal trace, or midrib (*d*); two ventral, or ovuliferous traces (*v*); and several smaller lateral traces, usually completely unlignified, numbering about twelve. These lateral traces, formed after the disorganization of the semicircular cylinder of residual traces to which attention has been called in the preceding paragraphs, progressively reduce in number as additional sections are examined. In diagram 10 of text-fig. 7, either carpel is seen to contain four lateral traces. In diagram 13 of the same figure, the lateral traces have completely disappeared. In diagram 9, also, the cycles of calycine (*c'*), corolline (*c''*) and staminal (*s*) traces are conspicuous, and in addition another cycle of traces, alternate with the staminal, and opposite the corolline, are evident. These are the traces to the cycle of nectaries (*n*), and they arise from the lobing of the corolline traces (*c''*) in exactly the same manner as did the dorsal traces of the carpels from the compound staminal traces. The manner in which the traces of the nectaries (*n*) emerge from adnation with the corolline traces (*c''*) is illustrated in diagram 9, where a large corolline trace is found constricting to free the trace of the nectary to which it is adnate.

Text-fig. 7, diagram 10, discloses for the first time the floral traces assuming their final position. Furrowing has begun to distinguish the carpels from the surrounding receptacle. In diagram 11, the calyx-lobes are becoming free of the receptacle, whereupon the single calycine strands separate into a large dorsal and two small ventral branches. Furrowing has completed the differentiation of the ovary walls.

In diagram 12, the calyx-lobes are entirely free from the receptacle, and each contains three traces. The nectary traces have likewise divided into three traces, and the shapes of the nectary-bodies have begun to be visible due to the inauguration of furrows. Diagram 13 proves that, even in the genus *Apocynum* which is described as possessing discrete nectaries, two of the bodies may develop together, evidently providing a transition to the coalesced annular nectaries of *Poacynum*. In diagram 13, also, furrowing, which has differentiated the nectaries, has served to demark the bases of the epipetalous stamen-filaments. The corolline traces

(c'') soon branch, forming a strong dorsal trace and two finer ventral branches.

In diagram 14 the corolla-tube, adnate stamen-filaments, and nectaries are fully differentiated, as they are viewed in ordinary dissections. The lobes of the corolla each contain three traces, but the lateral traces of the calyx-lobes have disappeared, leaving only the midrib. The lateral traces of the nectaries have also disorganized, for the most part.

The foregoing discussions of the floral anatomy of *Nerium* and *Apocynum* are incomplete and lacking in detail, but they are included in the discussion to aid in the interpretation of the vestigial structures believed to be present in those genera. A detailed account of the floral anatomy of many representative genera of Apocynaceae is in the course of preparation.

From the immediately preceding paragraphs it has been explained with regard to the anatomy of *Apocynum* that (1) the vascular supplies of the carpels and the nectaries are of similar origin; (2) the carpels and the nectaries are similar in containing dorsal and ventral traces; (3) the bodies of the carpels and the nectaries differentiate from the receptacle in a similar manner and at about the same time. An additional similarity of the carpels and the nectaries is the fact that both are made up of highly glandular cells, and thus assume a similar staining reaction in microscopical preparation. For these reasons, in addition to certain others, as similarity in shape (*cf.* text-fig. 10), the nectaries are interpreted in this study as sterile carpels, and are considered as of great value in phylogenetical speculations concerning the Apocynaceae.

Of course if one is merely inclined to take the view that the nectaries are vestigial, and consider their number and alternate position with the stamens, they might be interpreted as staminodia. Such an interpretation of an inner cycle of staminodia has been adopted by systematists with regard to the nectaries of *Parnassia*, and recently Mrs. Arber²² has expressed her approval of this view. On the other hand, subsequent studies may lead to the interpretation of these vestigial organs of *Parnassia* as sterile carpels, as in the case of *Apocynum*.

²² Arber, Agnes. On the structure of the androecium in *Parnassia*, and its bearing on the affinities of the genus. Ann. Bot. 27: 491-510. pl. 38. 4 figs. 1913.

In a systematic arrangement of taxonomic units, one is forced to grant a prior position to some and a subsequent position to others. It is very difficult for most taxonomic systems to depict accurately the probable evolution and phylogeny of the particular group. In arranging the three subfamilies of Apocynaceae, one is confronted with the problem of which should be first enumerated, since that position is tacitly interpreted as the "most primitive." And although one realizes that evolution is so complex and phylogeny so incomplete that the true situation is inscrutable, one is nevertheless forced to a conclusion, and must reconstruct his personal conception of what the whole edifice of nature might have been were all the elaborate units of structure still extant, with only the meagre materials which he has at hand.

In deciding the question regarding the probable relation between the three subfamilies of Apocynaceae, one is confronted primarily by considerations of distribution, habit and structure.

Geographically, the Apocynoideae are sharply distinct from the other subfamilies of Apocynaceae in having a completely north temperate habitat. The genus *Apocynum* is found scatteringly in northern Mexico as far south as central Chihuahua, but there is apparently escaped from ballast. It is as nearly cosmopolitan over the United States and southern Canada, including Newfoundland, as almost any other genus native to this continent. *Trachomitum* is a more southerly genus, and is found in Adriatic Italy, in Asia Minor, and in Asia as far south as the Persian Gulf and as far north as the vicinity of Peiping. *Poacynum* is apparently confined to a small district in central Asia.

Since the overbearing majority of all Apocynaceae is distinctly tropical (only seven or eight genera out of a total of over two hundred are characteristically temperate), it has been presumed that the group has probably had a tropical origin. Hence, with such an assumption, the Apocynoideae might be taken as representing an advance from the tropical condition of the Echitoideae and the Plumerioideae.

Closely coinciding with the geographical conclusions are considerations of habit of the subfamilies. The Apocynoideae are rhizomatous herbs entirely, while the Echitoideae and Plumerioideae are woody vines, clambering or procumbent under-shrubs

or trees, primarily, since the herbaceous habit is only rarely found in those groups. However, of the two subfamilies the latter contains the more numerous and the more typical herbs. *Amsonia*, *Rhazya*, and *Vinca* are rhizomatous perennials of the *Plumeroideae*, the former genus frequently developing a woody condition of the rhizome. *Lochnera*, of the same group, contains the only annuals of the entire family.

In the *Echitoideae* the herbaceous habit is much more rare. *Cycladenia* is a small sub-alpine rhizomatous perennial. Several genera, as *Macrosiphonia*, *Dipladenia*, and certain species of the inclusive genus *Echites* (cf. *E. stans* A. Gray) have become diminutive under-shrubs, apparently on the verge of the herbaceous habit. The herbaceous condition is now almost universally viewed as an adaptation from a woody condition, and the fact that the *Apocynoideae* contain only herbaceous genera in contrast to the predominately woody genera of the other subfamilies should lend support to the hypothesis that that subfamily demonstrates a relatively "advanced" condition.

From the standpoint of structure, consideration naturally centers about the condition of the mature pollen and the interpretation of the vestigial organs. That the tetradsenous pollen of the *Apocynoideae* should be considered as phylogenetically more advanced than the granular pollen of the other groups can scarcely be gainsaid. In the condition of the mature pollen, the *Apocynoideae* share with the *Asclepiadaceae* an interesting analogy with the *Orchidaceae*.

Since the *Apocynoideae* are interpreted as phylogenetically more advanced than the *Echitoideae* and *Plumeroideae* in other particulars, it might be reasonable to suppose that in the former subfamily the calycine squamellae have been totally effaced. Another view might be that the group is descended from an entirely different phylum than are the *Plumeroideae* and *Echitoideae*. Additional anatomical studies, it is hoped, will contribute to the elucidation of this problem. However, since it is known that the squamellae are eventually obliterated in certain genera of the *Plumeroideae*, the former view appears the more plausible.

Two recent memoirs concerning the phylogeny of the families of *Contortae* are of especial interest with reference to the family

Apocynaceae. The first is the portion of Wernham's²³ treatises on "Floral evolution" concerning the Contortae. In his deliberations, Wernham comes to the conclusion that the "apocynal stock," represented by the present family Apocynaceae, should be considered the most primitive group of the order Contortae and the Sympetalae as a whole. This conclusion is reached because that family, in general, demonstrates the simplest condition of all the families in its apocarpous, bicarpellate gynoecium. Although agreeing perfectly with Wernham's main thesis concerning the probable relationship between the Apocynaceae and the other families of the Contortae, several of his statements should be supplemented or modified in the light of the foregoing observations regarding the morphology of the family.

In conjecturing a group of Archichlamydeae which could possibly be regarded as offering a stock from which the Contortae (through the "apocynal stock") could be obtained, Wernham²⁴ exclaims: "A gulf is thus discovered between the Contortae and the Archichlamydeae which at first sight seems difficult to bridge; for the combination of an isomerous alternating androecium with a bicarpellary and *superior* ovary is extremely rare in the latter series—the sole group in which this combination occurs at all to *any extent* being the highly evolved Umbelliflorae, in which the ovary is inferior." Again he states: "In the Archichlamydeae, however, we must contemplate the tendency to economy from the aspect of its progress rather than of its realization; and the rarity of forms which have fully worked out this tendency before adopting sympetaly is scarcely matter for surprise. For the ancestry of the Contortae we must look for a group in which a tendency to isomery of the androecium is definitely traceable, together with a tendency to a bicarpellary gynoecium; at the same time *any tendency to epigyny must be absent*, or practically absent. These conditions are satisfied by the stock represented in the Geraniales-Sapindales plexus, and by no other." Still again he remarks: "Unfortunately, however, the Contortae have left no traces of their *progress from polypetaly to sympetaly in the*

²³ Wernham, H. F. *Floral evolution: with particular reference to the sympetalous dicotyledons.* *New Phytologist* 10: 217-266. 1911.

²⁴ *I. c.* 220. 1911.

shape of *pentacyclic forms*; neither a second staminal whorl nor any hint of it ever occurs." The italics are ours.

The treatises of Wernham, it may be said, are quite generally stimulating to the study of phylogeny, which, as some critics have remarked, is the only phase of taxonomy which at present appears to have any vitality. However, as is evident from the few quotations which have been included in the preceding paragraph, his opinions, like those of many another phylogeneticist, were very evidently formulated from faulty morphological observations. Although by no means representing all points of objection and exception which might be made to Wernham's phylogenetical ideas, several of his misleading morphological remarks should be recalled, namely: (1) that the ovary of the Apocynaceae is superior, and hence that "any tendency to epigyny must be absent, or practically absent" in a prospective hypothetical group of ancestors for the family; (2) that in the Apocynaceae there are "no traces of their progress from polypetalry in the shape of pentacyclic forms"; and (3) that "neither a second staminal whorl nor any hint of it ever occurs."

As early as 1857, Payer²¹ referred to the genus *Apocynum* as an excellent example of the ontogenetical adnation and coalescence of floral parts. In his morphological experiments Payer found that in very young flower buds the corolla of *Apocynum* is polypetalous, the pistil completely apocarpous, and the stamens free from the corolla. To these observations of Payer, all of which have been independently confirmed during the course of these studies, additional ontogenetical details have been added.

Diagrams illustrating two stages in the development of the flower of *Apocynum hypericifolium* are presented in text-fig. 8. In diagram A, the ovary appears inferior and the young stamens epigynous and organically free from the corolla. The receptacle is adnate to the whole outer surface of the carpels except at the apex where the clavuncle has not yet been formed by the fusion of the carpillary apices. In diagram B, the flower has assumed its mature condition. The stamens are now perigynous, for the carpels have developed above the surface of the receptacle. The

²¹ Payer, J. B. *Traité d'organogénie comparée de la fleur* 1: 564-565; 2: pl. 116. 1857.

bases of the stamen filaments, meanwhile, have fused in their superficial tissue with the base of the corolla-tube, thus developing their epipetalous position. However, as pl. 3, fig. 4 clearly demonstrates, this adnation of the filament to the corolla is scarcely complete adnation, for the vascular element of the stamen fuses with that of the corolla-tube only below the surface of the receptacle. The surrounding cells of the filament, moreover, never completely lose their identity in the adnation with the corolla.

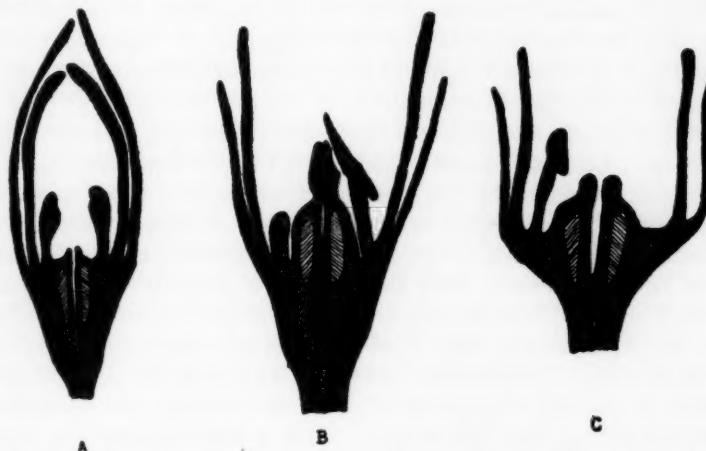


Fig. 8. Diagrammatic longitudinal sections of the flowers of species of *Apocynum* and *Saxifraga*: A, young bud of *A. hypericifolium*; B, mature flower of same; C, mature flower of *S. nivalis*.

As text-fig. 8, diagram B, illustrates, the ovary of *Apocynum* never becomes completely free of the surrounding receptacle, for the loculae are seen to penetrate into it. This penetration of the loculae is also conspicuous in the transverse sections of *Nerium* (text-figs. 4-5) and *Apocynum cannabinum* (text-figs. 6-7). This condition has been called "subinferior" by Dr. A. M. Johnson²⁸ and certain other specialists who note its occurrence in the genus *Saxifraga* and throughout the family *Saxifragaceae* in varying

²⁸ Johnson, A. M. A revision of the North American species of the section *Boraphila* of the genus *Saxifraga* (Tourn.) L. Univ. Minn. Biol. Studies 4: 6. pl. 5. 1923.

degrees. A diagram of the mature floral structure of *Saxifraga nivalis* in longitudinal section is presented in text-fig. 8, diagram C.

That the floral structure of the Apocynaceae is fundamentally pentacyclic there can be little room for doubt. The floral envelopes, the androecium, the groups of squamellae and nectaries, are invariably in fives. The gynoecium alone being bicarpellate, typically, would appear to detract from the 5-merous symmetry. However, a 5-8-carpellate gynoecium actually occurs in the family in the genera of the tribe Pleiocarpeae. The case of the Pleiocarpeae can scarcely be viewed as other than an indication of the primitive condition of the family, in the light of what phylogenetic studies in general, and the floral anatomy of *Apocynum* in particular, have taught.

The anatomy and probable significance of the calycine appendages have been elaborated in some detail in previous paragraphs. However, it might be appropriate to add in this place reasons accounting for the existence of staminal vestiges *outside* the gamopetalous corolla. If gamopetaly is considered as an adaptation from polypetaly, and there are few indeed who do not accept such an interpretation, we have in the five-lobed corolla of the Apocynaceae the homologue of five individual petals. Within such a polypetalous flower, let us conjecture an androecium of two or more cycles of fives surrounding the partially inferior, bicarpellate gynoecium. Such a flower is more or less typical of the polypetalous Saxifragaceae. In the Saxifragaceae, moreover, the outer cycle of stamens, alternating with the petals, frequently becomes adnate to the tube of the calyx. In such a case, if the outer cycle of stamens should become sterile during the process of centripetal sterilization, a very common occurrence, the assumption of gamopetaly by the corolla would certainly exclude the staminal vestiges from the confines of the corolla in what might be considered a manner precisely similar to the exclusion of the calycine squamellae by the gamopetalous corolla of the Apocynaceae.

On the other hand, let us imagine the remote ancestors of the Apocynaceae, as many another angiosperm, as possessing no sharply defined corolla, but only a many-seriate androecium illustrating centripetal sterilization, as in the flowers of *Mentzelia*,

etc. In such a flower could it not be conceived that very extreme sterilization, adnation, and finally coalescence could produce such a flower as that of *Nerium*: the squamellae (which in teratology develop into two to several flanged petals similar to those of the gamopetalous corolla) representing the outer cycles of the androecium which have become extinguished due to the infinite continuation of centripetal sterilization and adnation to the calyx-tube; the gamopetalous corolla representing an inner cycle of sterilized micro-sporophylls which have coalesced; and the cycle of highly evolved and largely sterile stamens representing the innermost and last cycle of the once many-seriate androecium? Such an explanation of the condition of the single flower of *Nerium* is forcibly suggested by the appearance of the adenopetalous, or double, flowers, where the adenopetaly is frequently accompanied by dialysis of the gamopetalous corolla.

From what has been explained concerning the anatomy and histology of the Apocynaceae in the foregoing paragraphs, we find that (1) the ovary of the Apocynaceae is not superior, but "semi-inferior," as in certain families of the Rosales, especially the Saxifragaceae; (2) therefore the stamens should be considered as perigynous, and in young stages they are practically epigynous; (3) the ontogeny of such a flower as that of *Apocynum* indicates very clearly its progress from polypetaly in the late coalescence and adnation of floral parts; (4) pentacyclic gynoecia are present in the tribe Pleiocarpeae of the Plumeroideae; (5) although the theory of the calycine squamellae as staminal vestiges has not been absolutely proven, such an interpretation is both attractive and plausible.

In view of the preceding considerations, it appears rather unnecessary for Wernham to assign the ancestry of the Contortae to the "Geraniales-Sapindales plexus, and . . . no other." The Rosales, and in particular a more primitive condition of the present Saxifragaceous condition, provide a more accurate and a far more plausible affinity. Instead of appearing as a "gulf which at first sight appears difficult to bridge," the hypothetical connection between the Archichlamydeae and the Sympetalae via the Saxifragaceae- and Apocynaceae-plexus appears astonishingly close and clear. The relationships among the families of

Contortae are indeed fascinating, and it is intended that further studies will concern that problem.

In 1922 there appeared a very significant paper by Demeter²⁷ upon the morphology of the Asclepiadaceae. Although without the general consideration of the present studies, attention should be called to certain conclusions which were drawn. Briefly stated, the author found that the only real difference between the Apocynaceae and the Asclepiadaceae lies in the translators of the latter. The two families are also closest linked by the genera *Apocynum* and *Periploca* of either family through the pollen characteristics (persistent tetrads). Hence the author considered it proper to merge the two families into a single large group as Jussieu²⁸ conceived them. He also called attention to the fact that the tetradenous pollen of *Apocynum* forms a mass which may be transported in a single bulk of many tetrads by visiting insects, somewhat resembling the pollinia of the Asclepiads. Finally, the author reunites the two families and revises the bulk into three subfamilies: 1. *Apocyneae*; 2. *Periploceae* (including the genus *Apocynum*); and 3. *Asclepiadaceae*.

Demeter's reasons for reuniting the Apocynaceae and the Asclepiadaceae are scarcely original. Adanson, Giseke, and A. - L. de Jussieu advanced very similar opinions in the early years of the nineteenth century. A. de Candolle²⁹ retained the separation by Brown, explaining that he did so although aware that the only clear-cut distinction is the organization of the pollen.

Like de Candolle, Baillon³⁰ also was forced to admit that: "Les Asclépiadées ont tous les caractères des Apocynées, sauf ceux de leur pollen qui est réuni en masse." However, as Garcin³¹ states: ". . . nous ferons remarquer que toute une tribu d'Asclépiadées, les Périplocées, qui comprennent de nombreux genres, ont un pollen libre et forment ainsi une transition insensible aux Apocynées. D'autre part le *Vinca Rosea* a un pollen agglu-

²⁷ Demeter, K. Vergleichende Asclepiadidenstudien. *Flora* 115: 130-176. 1922.

²⁸ Jussieu, Gen. Pl. 143-151. 1789.

²⁹ A. DC. Mémoire sur les Apocynées. *Ann. Sci. Nat. Bot.* III. 1: 255-258. 1844.

³⁰ Baill. *Traité de botanique médicale phanérogamique*. 1277. 1884.

³¹ Garcin, A. G. Recherches sur les Apocynées. *Ann. Soc. Bot. Lyon* 15: 220-221. 1888.

tiné." The same author, moreover, found that the histology of the two groups is practically identical.

Although they certainly bear an extremely close affinity to one another, it is here considered better to continue the Apocynaceae and the Asclepiadaceae as separate families, even allowing the translator of the latter group, an extremely significant and specialized structure, to be the chief difference. However, the connection between the Apocynoideae and the Periplocoideae is unmistakable.

At the conclusion of this morphological and phylogenetical discussion, the writer takes particular pleasure in acknowledging his gratitude to Dr. A. J. Eames, of Cornell University, who read the manuscript and encouraged its publication.

THE GENERA OF APOCYNOIDAE

Among the three genera of the subfamily Apocynoideae several significant and easily distinguishable indicators of phylogeny appear. Of these perhaps the most conspicuous, as well as one of the most significant, concerns the composition of the inflorescence. The inflorescence of *Apocynum* is a trichasium while that of *Poacynum* and *Trachomitum* is a monochasium. Phylogenetically, the trichasium is almost universally conceded to be a more primitive structure than the monochasium, and the justice of that view is shown by additional characteristics of the three genera.

The corollar appendages which have already been described with reference to *Apocynum* and *Nerium* are another source of valuable distinction. In the American genus *Apocynum*, as has already been explained, they are individual (*cf.* text-fig. 10, diagram 2g), while in the Eurasian genera *Poacynum* and *Trachomitum* they are coalesced into the form of a ring which appears more reduced in the former genus than in the latter (pl. 20).

An additional character of undoubtedly phylogenetic significance is the state of the nectaries, which are distinct and separate in *Apocynum* and *Trachomitum* and more or less coalesced into an annulus in *Poacynum*. Additional characters in the separation of the two latter genera are the tubular-campanulate corolla and opposite leaves of the former, and the pelviform corolla and alternate leaves of the latter.

KEY TO THE GENERA

Inflorescence trichasial; corollar appendages distinct and separate, not coalesced into a ring; corolla glabrous or very rarely irregularly hirtellous; auricles of the anthers parallel; genus of North America. I. *APOCYNUM*

Inflorescence monochasial; corollar appendages coalesced into a ring; corolla uniformly pulverulent-papillose without; auricles of the anthers convergent; genera of Eurasia.

Corolla tubulo-campanulate; nectaries distinct, not coalesced into a ring; pedicels single, not conspicuously paired; leaves opposite. II. *TRACHOMITUM*

Corolla peltiform, without a definite tube; nectaries more or less coalesced into a fleshy annulus about the carpels; pedicels conspicuously paired; leaves alternate. III. *POACYNUM*

Sufficient has been indicated of the relationship of the three genera of Apocynoideae in the preceding paragraphs; details concerning each will be reported in the revisions which follow.

SUMMARY

1. An historical account is given of the systematic arrangement of the Apocynaceous genera from the time of Tournefort to the present.
2. A new systematic arrangement of the family Apocynaceae is presented, based partially upon the system of K. Schumann in Engler & Prantl's 'Die natürlichen Pflanzenfamilien' and partially upon the results of original morphological investigations.
3. The genera *Apocynum*, *Trachomitum*, and *Poacynum* are segregated into a new subfamily based upon tetradenous pollen and an eglandular calyx.
4. The floral morphology and teratology of the genus *Nerium* are found to suggest explanations for several features of the floral organs of the Apocynaceae in general.
5. After a comparison of the calycine appendages or "squamellae" of representative Apocynaceae with the morphology and teratology of the single and double blossoms of *Nerium* it is conjectured that the calycine squamellae of numerous Apocynaceae may be interpreted as staminal vestiges which were excluded from the interior of the flower by gamopetalry.
6. The fleshy nectaries surrounding the carpels of numerous genera of all groups of Apocynaceae are perceived to be anatomically and ontogenetically similar to the carpels and are interpreted as a cycle of sterile carpels.

7. Close relationship of the Apocynaceae with the Saxifragaceae is indicated by (1) the bicarpellate and "semi-inferior" gynoecium; (2) the interpretation of the calycine squamellae as homologous to staminal whorls; (3) the polypetalous condition of very young flower-buds; and numerous other details of the morphology, anatomy and ontogeny.

8. Two recent and important treatises dealing with the phylogeny of the Apocynaceae are reviewed.

9. A key is provided to the genera of Apocynoideae, which are briefly described and contrasted.

II. A MONOGRAPH OF THE GENUS APOCYNUM

INTRODUCTION

"When the Synoptical Flora, Vol. 2, part 1, was issued in 1878, only two species of *Apocynum* were recognized in North America, viz., *A. androsaemifolium* and *A. cannabinum*, and the distinction between them was none too marked. At the present time there are some thirty species recognized in North America, which as a rule are referred to one or the other of the two groups based on these original species. The result is that a sort of 'apocynal chaos' obtains such as we find existing in only too many of the so-called 'tough groups'." Thus the author²² of a new species of *Apocynum* prefaces his description. Upon bringing his observations to a close, he further remarks in none too reassuring a vein: "The plant . . . cannot be referred to any recognized species, and as its characters are fully as distinctive as any of the genus, I have felt justified in proposing it as the type of a new species."

Since the time of the above writing, this "chaos" has become more and more perplexing, for in the period between 1910 and 1928 more than eighty additional North American species of *Apocynum* have been described, sixty of these having been proposed by the late Edward L. Greene. Beside these have accumulated many new varieties and forms. In spite of the many additions to the genus, however, many botanists still refer the various Apocyna to two or three species in identification, un-

²² MacGregor, E. A. Bull. Torr. Bot. Club 37: 261-262. 1910.

doubtedly because of the tenuous differentia to be encountered in an attempt to segregate them more accurately.

In 1913 a monograph of *Apocynum* was published by two Italian botanists,²³ which, however, for several cogent reasons is unsatisfactory to American botanists. In the first place, direct familiarity of the genus by the authors was confined to the few Eurasian representatives, constituting only about 10 per cent of the specific aggregate; knowledge concerning the North American species, constituting fully 90 per cent of the genus as conceived by the authors, was limited apparently to specimens borrowed from the United States National Herbarium. Secondly, analytical drawings are not present save for a very few of a general and elementary nature, which are diagrammatic to the point of obscuring morphological details of considerable importance. Thirdly, the citations of the authors are practically useless and frequently absolutely unintelligible,—evidently merely guesses of what the English inscriptions upon the labels of the American specimens might likely be, producing page upon page of what Prof. Fernald,²⁴ while referring to the paper in a recent review, has aptly called "Jabberwocky." All in all, the monograph is more of a curiosity than a scientific work.

The condition of the genus at the present time not only warrants another attempt at an adequate treatment of the group, but renders imperative a careful morphological study to substantiate the taxonomy of such a treatment. The present revision is an attempt to portray the evolutionary complexity of the genus as it appears to all who study it in the field, and at the same time to confine the specific concept applied to it within the bounds of practicality. To this end, extensive field studies have been made during five summers, embracing practically all of the species and varieties recognized. The collections of the genus in all the larger herbaria of the United States have been personally visited, and from several of the lesser herbaria abundant material for study has been borrowed through the courtesy of the various curators. Upon a smaller scale, breeding observations including both

²³ Béguinot, A., & Belosersky, N. Revisione monografica del genere *Apocynum* Linn. R. Accad. Lincei Atti, Mem. Cl. Sci. Fis. V. 9: 595-734. 18 pl. 18 figs. 1913.

²⁴ Fernald, M. L. Science N. S. 68: 146. 1928.

Apocynum and the closely related genus *Trachomitum* have been undertaken in the experimental gardens and greenhouses of the Missouri Botanical Garden.

During the course of this study of the Apocynoideae, and in particular the genus *Apocynum*, two years were spent at the Missouri Botanical Garden, and one year at the Gray Herbarium of Harvard University. For the use of the herbarium, library, and laboratory facilities, as well as for the other conveniences of the Missouri Botanical Garden, the author is indebted to Dr. George T. Moore, the Director of the Garden. For the use of the excellent facilities for study at the Gray Herbarium, as well as for valuable advice and innumerable courtesies, he is likewise happy to acknowledge his obligations to Dr. B. L. Robinson, Curator of the Gray Herbarium, and also to the other members of the staff of that institution, particularly Prof. M. L. Fernald, and Dr. I. M. Johnston.

In connection with his visits to various herbaria of the country, the author desires to acknowledge the courtesy and hospitality of Dr. N. L. Britton, Dr. P. A. Rydberg, and Mr. Percy Wilson, of the New York Botanical Garden; Dr. F. W. Pennell, of the Philadelphia Academy of Natural Sciences; Dr. W. A. Maxon, Mr. T. H. Kearney, and Mr. E. P. Killip, of the United States National Herbarium; Dr. J. A. Nieuwland, in charge of the herbarium of Dr. Edward L. Greene at the University of Notre Dame; and Messrs. P. C. Standley and J. F. Macbride, of the herbarium of the Field Museum.

For the use of borrowed specimens of the genus *Apocynum*, the author is indebted to Dr. P. A. Munz, of the herbarium of Pomona College, to Prof. Harold St. John, of the State College of Washington, and to Mr. C. C. Deam, of Bluffton, Indiana, whose unexcelled private collection of Indiana plants proved an invaluable addition to the specimens of the various endowed institutions.

In the course of study of such a problem, material aid is frequently given by numerous friends, and for much assistance in the prosecution of these studies the author desires to thank the following: Dr. Edgar Anderson, Dr. D. H. Linder, Miss Nell Horner, Mr. Julian A. Steyermark, and Mr. Harry Fuller, of the Missouri Botanical Garden; Mr. Harry Piers, of the Provincial

Museum of Halifax, Nova Scotia; Mr. W. E. Saunders, of London, Ontario; and his father, Mr. Robert E. Woodson, Sr.

Finally, the author wishes to express his gratitude for aid and courteous criticism to Dr. J. M. Greenman, Curator of the herbarium of the Missouri Botanical Garden.

HISTORY OF THE GENUS

It is generally admitted that Dioscorides was the originator of the name *Apocynum*, and the purgative potentialities of the 'Απόκυνον, as his Greek original existed, were fully known to him. The medicinal use of the rhizomes of the plant were also appreciated by Pliny and Galen, who derived the word *Apocynum* from the Greek. The plant was so named from a composition of the Greek words ἀπό, *from, far from*, hence meaning "bane," and κυνός, *of a dog*, implying the use of a decoction of the plant as a poison for wild dogs and other animal pests.

The identity of the plants called 'Απόκυνον by Dioscorides, and *Apocynum* by Pliny and Galen, as true *Apocyna* in the modern sense, however, has been brought into question by some antiquarians,³⁵ who contend that the plants mentioned by the ancient writers were more likely referable to the genera *Cynanchum* and *Marsdenia*, both members of the *Asclepiadaceae* occurring in Mediterranean, Adriatic, and Aegean lands. Sibthorp³⁶ upholds such a view, and confidently refers the *Apocyna* of the ancients to *Cynanchum erectum* L.

Recently the late Dr. Lunell,³⁷ pursuing his views of absolute priority, has changed the name of the North American *Apocyna* to *Cynopaeama*, upon the testimony of Sibthorp that the *Apocynum* of the ancients was in fact *Cynanchum*.

Although the name *Apocynum* appears consistently throughout the herbals from the time of Pliny to the middle of the seventeenth century, no direct proof that the name was then applied to a rightful member of that present genus can be found until 1669, when Robert Morison's 'Praeludia Botanica'³⁸ appeared with the

³⁵ cf. Bartolozzi, F. Memoria . . . sopra le qualità che hanno i fiori della piante, &c. in Opusc. scelt. sulle scienze e sulla arti. p. 293, Milano, 1779.

³⁶ Sibthorp, J. & Smith, J. E. Flora Graeca 1: 178. 1806.

³⁷ Lunell, J. Am. Mid. Nat. 4: 508. 1916.

³⁸ Morison, R. Prael. Bot. 12. 1669.

first recognizable plate of that genus and with polynomial phrases which describe the plants fairly well for the first time. Seven *Apocyna* were listed and illustrated by Morison as representing all of the species known to him. With the aid of his plates and polynomials, it is fairly safe to state that of these seven various so-called *Apocyna*, three were undoubtedly true members of that present genus, and that all three were natives of North America. Thus, as early as 1669 the American element of that genus was evidently the one associated with the name *Apocynum*. This is accentuated by the fact that the Linnaean *Apocynum venetum*, taken by some to be the type species of the genus, was yet included in the same work as "*Tithymalus maritimus, venetus, . . .*" The three plants of Morison, taken to be referable to North American species of the present genus *Apocynum*, are his "*Apocynum Canadense foliis Androsaemi*," "*Apocynum Canadense angustifolium flo. aureo*," and "*Apocynum Canadense angustifolium maximum flore minimo herbaceo*." After each of these phrase names, the sign \mathfrak{G} appears, denoting that the combination had originated with Morison himself.

Tournefort,¹⁰ in 1700, provided *Apocynum* the most competent treatment with which it had ever before been accorded. He recognized in his generic description two main divisions, the first coinciding well with our present genus *Apocynum*, and the second equally well with the existing genus *Asclepias* and its immediately neighboring genera. This was the first well-defined break in the solidity of the great amorphous aggregate then called by the name *Apocynum*. Tournefort made the distinction of his unnamed divisions still more evident by referring each to a well-prepared analytical plate, presenting in themselves indisputable evidence of their individuality.

In Tournefort's treatment of the genus for the first time appears the European element of the Linnaean genus *Apocynum*, *A. venetum* L. as "*Apocynum maritimum, Venetum, Salicis foliis, siliqua longissima*." Preceding the "*Apocynum maritimum, . . .*", however, appear *Apocynum cannabinum* L. as "*Apocynum Virginianum, flore herbaceo, siliqua longissima*," and *A. androsaemifolium* L. as "*Apocynum Indicum, foliis Androsaemi majoris*,

¹⁰ *Tourn. Inst. 2: 91-94. 1700.*

flore Lilii Convallium serrarubentis," implying that the author was more familiar with the two preceding than with the following "*Apocynum maritimum*, . . ." and desired the reader to be conscious of that fact.

The fifth edition of Linnaeus' "Genera Plantarum"⁴⁰ was no improvement over Tournefort's "Institutiones," as far as the genus *Apocynum* is concerned. Although restricting the genus within smaller bounds than had Tournefort, the group was scarcely more homogeneous. Linnaeus' "Species Plantarum"⁴¹ recognized five species of *Apocynum*, as follows: (1) *A. fol. androsaemi*,⁴² (2) *A. cannabinum*, (3) *A. venetum*, (4) *A. frutescens*, and (5) *A. reticulatum*. The first three species have remained until now as the traditional species of the genus, while the fourth and fifth have been transferred to other genera.

It is not thought expedient here to devote further space to the history of the specific concept of the genus *Apocynum*. Suffice to limit the present remarks to less obvious features of the problem. In 1748 Heister⁴³ listed during the course of a synopsis the genus *Apocynastrum*, corresponding to the "Apocynum Canadense foliis Androsaemi" of Morison; separating it from the typical *Apocynum* as represented by Morison's "Apocynum Canadense angustifolium flo. aureo." Fabricius⁴⁴ in 1759 retained and amplified the description of *Apocynastrum*, although he referred no species to it. Jussieu⁴⁵ in 1789 altered the name of the genus to *Apocinum*, without transferring any species to the new generic spelling.

Reference has already been made to the work of Robert Brown, which did so much to clarify the specific complex of the genus

⁴⁰ Linnaeus, Gen. Pl. ed. 5. 101. 1754.

⁴¹ Linnaeus, Sp. Pl. ed. 1. 1: 213. 1753.

⁴² It is a little-appreciated fact that the first edition of the "Species Plantarum" published the familiar species of eastern North America as "*Apocynum fol. androsaemi*," and not as "*Apocynum androsaemifolium*," which appeared in L. Sp. Pl. ed. 2. 1: 311. 1762; and several floras, overlooking this, have referred to the species as "*Apocynum androsaemifolium* L. Sp. Pl. 1: 213. 1753." This latter familiar form is used throughout this monograph, although the rights of the former are duly acknowledged.

⁴³ Heistr. Syst. Pl. Gen. 8. 1748.

⁴⁴ Fabric. Enum. Meth. Pl. 256. 1759.

⁴⁵ Juss. Gen. Pl. 146. 1789.

Apocynum. Since the time of Linnaeus, species had been relegated to the genus carelessly and volubly, until a confusion had resulted which only the understanding of genus could clarify. The classic work of Brown⁴⁶ in ordering the chaos into two well-defined families, and finally into properly proportioned genera, will remain a monument for generations to come.

Alphonse de Candolle⁴⁷ accepted the conclusions of Brown in his synopsis of the genus in the 'Prodromus,' and his revision remained the last until 1913 when the monograph by Béguinot and Belosersky appeared, to which reference has previously been made.

Between 1844 and 1913, the only notable event in the history of the genus was in 1888, when Baillon,⁴⁸ after a study of the peculiar Asiatic element of the genus, segregated it from the mother genus, giving it for a name the anagram *Poacynum*.

GENERAL MORPHOLOGY

Roots.—The root system of all species of the genus *Apocynum* is extensive, filling the soil to a depth of three to four feet.⁴⁹ The root system is dual, comprising purely absorptive roots which are relatively fine and fibrous, ramifying the soil in the usual manner; and so-called "gemmaferous" roots, which are relatively stout and woody and assume a more or less horizontal position, presenting the general appearance of a rhizome. Plate 5, fig. 4, illustrates the subterranean axes of *Apocynum cannabinum*. As indicated in the figure, the fibrous absorptive roots (*f*) are produced freely along both the vertical rhizome (*a*) and the horizontal gemmaferous root (*e*), but principally upon the latter. The gemmaferous roots produce lateral buds (*c*) which at length develop into new vertical rhizomes. These new rhizomes are typical root-shoots,⁵⁰ such as those occurring in many arboreal genera as *Populus* and *Robinia*, and correspond to the "additional root-

⁴⁶ R. Br. *l. c.* 67-68. 1809.

⁴⁷ A. DC. in DC. *Prod.* 8: 439-440. 1844.

⁴⁸ Baill. *Bull. Soc. Linn. Paris* 1: 757. 1888.

⁴⁹ cf. Weaver, J. E. Root development of field crops. pp. 83-84. *fig. 28.* 1926.

⁵⁰ Holm, Theo. On the development of buds upon roots and leaves. *Ann. Bot.* 39: 867-881. 1925.

"shoots" of Wittrock.⁴¹ The young gemmiferous roots (*d*) are in turn produced laterally from the vertical rhizomes.

A fully mature gemmiferous root of *A. cannabinum* is usually .5-1.0 cm. in diameter, and may be several meters in length, giving rise to a dozen or more root shoots at one time. A single well-developed plant in a cultivated field may become spread by the plow-share to form colonies all over the field, the blade cutting the gemmiferous root into pieces and forming a new plant at each lateral bud. In this manner *A. cannabinum* and its varieties, especially, have become common pests of agriculture.

Plate 8 consists of two photographs of *A. medium* var. *lividum* growing in a cultivated field near Bayfield, Colorado. The photographs are unfortunately rather insufficient in detail, since an attempt was made to include as much in the plate as possible. Immediately adjoining the areas photographed were several areas of equal or greater extent. The part which vegetative propagation has played in obtaining the infested condition of the field may be appreciated when it is understood that the variety in question is evidently absolutely sterile, since no fruiting specimens have ever been found either in herbaria or in the field. The field photographed was visited in July, at which time not a single follicle or any indication of one, either young or of previous years, was found by the writer among the several thousand plants which infested it (see also p. 72). *A. androsaemifolium* and its near relatives, although possessing the same general form of rhizome and gemmiferous root, are more frequently found in woodlands, and are much less apt to invade cultivated land than *A. cannabinum* or *A. medium*.

A cross-section of a young absorptive root of *A. hypericifolium* is presented in pl. 4, fig. 1. The epidermis (*a*) is seen to consist of a single row of cells, from which numerous root hairs are produced. Within the epidermis lies an extensive cortex (*b*) consisting of about ten rows of rather spongy parenchymatous cells. In the center of the section, and occupying about one-third of the diameter, is found the stele, bounded by a rather poorly defined endodermis (*c*). The vascular structure is tetrarch in all of the

⁴¹ Wittrock, V. Br. Om rotakott hos örtartade växter, med särskild hänsyn till deras olika biologiska betydelse. Bot. Notia. 1884: 21. 1884.

cases examined, but has been found in a single instance to be pentarch. The four alternating masses of phloem (*e*) and xylem (*d*) are embedded in a conspicuous pericycle (*f*) composed of small and closely packed parenchyma. Larger and more loosely arranged parenchymatous elements occupy the center of the stele, and may be regarded as an elementary pith.

A sector of a cross-section of a fully mature gemmiferous root is presented in pl. 4, fig. 2. The secondary structure in such a root is very conspicuous. The epidermal cells have ceased to exist as such, and constitute a dead outer sheath, beneath which is a conspicuous periderm. The periderm consists of a several-layered phellem (*a*), a conspicuous and active phellogen (*b*), and a relatively inconspicuous phellogenderm (*c*). Within the periderm lies an extensive cortical zone (*f*), traversed by latex tubes (*h*). The cells of the cortex contain much storage starch, which will be separately considered subsequently. Within the cortex lies a broad cylinder representing a coincidence of secondary phloem and pericycle. Isolated areas of crushed and half-absorbed cells are conspicuous, which are thought to be the remains of the primary phloem and endodermis. A functional endodermis is evidently lacking.

Occupying the interior of the stele is a broad cylinder of secondary xylem (*d*), composed of parenchyma and conspicuous and very numerous vessels. Traversing the xylem are found conspicuous storage rays (*l*) which extend through the phloem and cortex to the vicinity of lenticels (*k*) in the bark. A well-defined and active cambium (*g*) separates the phloem and the xylem.

Stem.—The stem system of the genus *Apocynum*, like the root system, is dual, comprising a more or less upright aerial stem and a vertical subterranean rhizome, passing reference to which has already been made in the preceding paragraphs with regard to the root system.

The rhizome appears to be developed almost entirely from the hypocotyl, in plants propagated from seed, stem-buds appearing upon that axis either laterally or in the axils of the cotyledons. In producing lateral stem-buds upon the hypocotyl, which in seedlings of all herbaceous Apocynaceae is a very conspicuous organ, the genus *Apocynum* differs from the genera *Amsonia* and

Rhazya, and is similar to the nearly related genus *Trachomitum*. The rhizome may be regarded as merely an underground portion of the true aërial stem, with which it is more or less perfectly confluent, the foliage leaves of the aërial portion grading uninterruptedly to the inconspicuous cataphylls of the rhizome. Since *Apocynum* is a north temperate genus, the chief distinction between the proper stem and the rhizome is that the former is annual, while the latter is perennial. The first aërial stem of a young rhizome is terminal, but following ones, appearing after the destruction of the first, are always lateral. Since the internal anatomy of both rhizome and aërial stem is fundamentally identical, as we shall presently see, the differences between rhizome and stem are general habit and longevity, production of roots by the rhizome, and the production of foliage leaves by the stem. An important additional difference is the method of branching, which is according to a definite plan in the stem, unlike the rhizome in which branching is evidently haphazard.

Taxonomically and phylogenetically the stem of the various species of *Apocynum* offers characters of considerable value. The stem of *A. androsaemifolium* and *A. pumilum* and their varieties has a relatively lax, spreading habit, and the branches are preponderantly alternate. The stem of *A. cannabinum* and its allied species and varieties differs in its opposite or sub-opposite, somewhat fastigiate branching, and is chiefly erect in habit. The intermediate character of *A. medium* and its varieties is noticeable in the mode of branching, which is intermediate between that of *A. androsaemifolium* and *A. cannabinum*. The branching is alternate to subalternate by the abortion or deferred development of an opposite axillary bud. The habit is also intermediate, since, although it is erect and not lax as in *A. androsaemifolium*, it has not the fastigiate appearance of *A. cannabinum*.

Ecological conditions easily influence the height of the stem. Plants of *A. pumilum* may be only two or three centimeters in height when growing at very high altitudes. A plant of *A. androsaemifolium* growing in an exposed, dry or sandy environment may produce stems only a few centimeters tall; while a plant of the same species growing in a shady, moist woodland may exceed a meter in height. Although in every other respect quite typical,

unusual developments of the stem due to ecological conditions have frequently been described as new species.

The anatomy of the stem and rhizome presents interesting features for study. Although a detailed account of the developmental anatomy is without the scope of the present paper, it is thought that a general account of the cellular constitution may be helpful in securing a relatively broad conception of the genus.

Plate 5, figs. 1-2, represent sectors of cross-sections of the stem of *A. cannabinum* and *A. androsaemifolium*, respectively, the former at a somewhat earlier development than the latter. In both certain anatomical characteristics are conspicuous. The epidermis proper (a) consists of a single layer of cells in which stomata are occasionally to be found. Immediately beneath the epidermis is a hypodermis (b) composed of cells somewhat similar to those of the epidermis, but appearing laterally more compressed.

The cortex (c) is extensive, occupying from approximately one-eighth to one-third of the cross section. The cells of the cortex are characteristically spongy and parenchymatous; and contain resinous secretions occasionally, and stored starch grains almost invariably.

A cross-section of the stem stained with a combination of safranin and *licht gruen* or gentian violet detects the presence of starch in the cortex. The individual grains are roughly elliptical-discoid in shape, with a conspicuous and highly refractive hilum. Conspicuous and irregular fissures in the hilae are almost always perceptible. Illustrations of the included starch from the cortex of *A. cannabinum* are presented in pl. 5, fig. 5. Within the cortex proper the collenchyma differs from the strictly parenchyma by a lack or paucity of included starch.

Within the cortex the pericycle (j) appears as prominent and isolated groups of fibers of great length and strength, the use of which by the aborigines of North America as a constituent of rope and thread has caused the popular name "Indian Hemp" to be given *A. cannabinum*. Associated with the pericyclic fibers are groups of latex tubes.

The family Apocynaceae shares with other families of the order Contortae a bicollateral development of the stele. In the genus *Apocynum* the intraxylary phloem forms a conspicuous vascular

feature. The external phloem (*e*) forms a more or less continuous cylinder within the pericycle, and consists largely of fibrous elements. The irregular masses of pericycle, however, sometimes invade the zone of phloem, causing its disruption into discontinuous segments (fig. 2*j*).

The xylem (*g*) consists of a continuous hollow cylinder enclosing the internal phloem and pith. The woody elements are conspicuous and relatively few-angled. Vessels are not as numerous or as conspicuous as in the gemmiferous roots. The woody cylinder becomes greatly enlarged during the period of growth of the stem. In the young stem represented by fig. 1, the diameter is approximately 1 mm. and there are about seven rows of cells in the xylem. In a stem of about 1 cc. in diameter, the rows of xylem cells number about one hundred.

The internal phloem (*f*) in the genus *Apocynum* forms a rather loose, interrupted cylinder, separated from the xylem by a row or two of parenchymatous cells. The elements of the internal phloem are more parenchymatous than those of the external phloem.

The origin of the internal phloem in dicotyledons has been a disputable subject. According to Scott and Brebner,⁵² who devoted extensive research to the question, the internal phloem arises from the procambium. On the other hand, Héral⁵³ and Lamounette⁵⁴ are of the opinion that the internal phloem originates from the pith. In the course of the present studies it was not considered feasible to investigate this technical problem. The author, however, is inclined to accept the view of Scott and Brebner. The reader is referred to the literature.

The center of the stele is invariably occupied by a conspicuous pith (*h*). In young stems certain cells display included starch grains (fig. 1*i*), but that condition is rather rare. Frequently isolated latex tubes (*m*) appear in the region of the pith bordering the internal phloem.

⁵² Scott, D. H., & Brebner, G. On internal phloem in the root and stem of dicotyledons. *Ann. Bot.* 5: 259-300. *pl. 18-20.* 1891.

⁵³ Héral, J. Étude de la tige des dicotylédones. *Ann. Sci. Nat. Bot.* VII. 2: 267. 1885.

⁵⁴ Lamounette, B. Recherches sur l'origine morphologique du liber interne. *Ann. Sci. Nat. Bot.* VII, 11: 193-282. 1890.

The internal anatomical structure of the rhizome (pl. 5, fig. 3) is practically identical with that of the stem, differing chiefly in the possession of a distinct periderm (*b*), and conspicuous vascular rays (*k*). The vessels of the metaxylem of both the rhizome and the stem contain many-seriate, alternate bordered pits, closely pressed together and thus assuming a roughly hexagonal outline. Plate 4, fig. 6, illustrates the pitting of a tracheid of secondary xylem of *A. cannabinum*.

According to Scott and Brebner⁴⁵ internal centripetal wood occurs in the stem of *A. cannabinum*, associated with the internal phloem. According to those authors internal cambium makes its appearance all around the pith, forming on its outer margin fresh cells of internal phloem, and on its inner isolated masses of xylem amounting to a maximum of twenty-five elements, equal to about one-eighth of the normal wood. No internal wood was discovered in the stems of *Apocynum* which were studied in the course of this study. This failure may be accounted for by the fact that Scott and Brebner examined wood of greater diameter than that studied by the present writer. Another source of error may be fluctuation of this phenomenon.

The interpretation of the horizontal subterranean axis of the genus *Apocynum* as a gemmiferous root rather than as a horizontal rhizome is not of very common occurrence. Even anatomical studies have occasionally identified that axis as a rhizome.⁴⁶ From the stem and rhizome, however, the gemmiferous root differs in several conspicuous and concise anatomical features. As will be seen from a comparison of pl. 5, figs. 1-3, and pl. 4, fig. 2, the stem and the rhizome possess pericyclic fibers, internal phloem, and central pith, as well as resinous cortical cells, which the gemmiferous root does not. The latex tubes of the stem and rhizome occur in association with the pericycle, whereas those of the gemmiferous root occur in the cortex. In addition, the xylem of the gemmiferous root differs from that of the stem and the rhizome in the greater size and number of vessels and the more parenchymatous nature of the cells.

⁴⁵ Scott, D. H., & Brebner, G. *I. c.* 283-285. *pl. 19, figs. 13-14.* 1891.

⁴⁶ cf. Garcin, A. G. *Recherches sur les Apocynées.* Ann. Soc. Bot. Lyon 15: 210-221. 1888.

Leaves.—The leaves of the genus *Apocynum* are opposite, membranaceous, entire, and either distinctly petiolate or sessile. Superficially they may be either glabrous or variously pubescent. The outline and surface of the leaves are extremely polymorphic, which fact has been the cause of much of the taxonomic confusion regarding the specific complex of the genus. Leaf size, shape, and pubescence or glabrous are characters evidently to be considered with caution. Two foliar characters are evidently reliable, however. These characters are the relative shape upon the primary axis of the plant, and the position which the leaf takes with regard to the axis of the stem.

Illustrating the former category, it can be shown that the majority of the species possess leaves which are nearly uniform throughout the plant, at least in shape; while others, as *A. hypericifolium* and its varieties, have leaves which are relatively broad, blunt, sessile, and cordate or amplexicaul upon the primary axis, while those upon the secondary axes may be petiolate and relatively narrow, giving the plant a somewhat heterophyllous foliage.

The second category is illustrated by the leaves of *A. androsaemifolium* and its allies, which are drooping and somewhat pendulous; by those of *A. medium* and its allies, which spread at nearly right angles to the axis of the stem; and by those of *A. cannabinum* and its allies, which ascend from the main axis.

Connecting the base of the petioles of each pair of leaves occurs an inconspicuous ring of triangular, membranaceous, pectinate glands 1 mm. or less in greatest dimension. These appendages are superficial in origin, and whatever their origin or function is difficult to determine, since they present no distinct anatomical clue to their identity. They are probably best regarded as Lindley⁵⁷ regarded them, as vestiges of stipules, for a critical examination of them shows that they are connected by a shallow annular lamina.

In studying the morphology and anatomy of the foliage of *Apocynum*, *A. androsaemifolium* and *A. cannabinum* were selected

⁵⁷ Lindley, J. Nat. Syst. ed. 2, 300. 1836. Lindley regarded the stipular glands which he observed in several genera of the Echitoideae as evidence of relationship with his family Cinchoniaceae, the stipules of which are conspicuous.

as contrasting objectives. Representative sectors of cross-sections of leaves of either species are represented in pl. 6, figs. 5 and 4, respectively. The leaf in either case is a typical dorsiventral mesophyll.

The epidermal layers consist of only one layer, in either case, and are composed of relatively even and regular cells upon the upper surface (a), and relatively irregular and loose cells upon the lower surface (b). The mesophyll of either species is highly developed. In *A. cannabinum* (fig. 4) the ratio of palisade to spongy parenchyma is about 3 : 2. The palisade cells (c) in that species are rather compact oblong-ovoid cells, and are arranged in two to several layers. The spongy parenchyma (d) is composed of larger, flabby cells, rather distantly and irregularly arranged, forming numerous air-chambers.

The ratio of palisade to spongy parenchyma in leaves of *A. androsaemifolium* is rather higher, about 3 : 1. The palisade cells (c) are more uniform than in the preceding species, in shape, size, and arrangement, constituting a single layer of cells. The spongy parenchymatous cells (d) are similar to those of *A. cannabinum*.

The difference in the number of layers of palisade cells between *A. androsaemifolium* and *A. cannabinum*, noted in the preceding paragraph, forms a tangible and evidently constant internal distinction between the two species. The number of layers is not dependent upon ecological conditions, as experiment has proven. Both in the studies of Mrs. Clements⁵⁸ with the former species, and of those of the present investigation with the allied species of the genus, the number of layers of palisade cells has appeared constant. In the species intermediate between *A. androsaemifolium* and *A. cannabinum* the layers of palisade cells vary from one to several.

Evidently stomata occur only on the lower surface of the foliage. These organs are most frequently accompanied by two or more subsidiary cells which are placed parallel to the pore, simulating the "Rubiaceous type" of Solereder.⁵⁹

⁵⁸ Clements, E. S. The relation of leaf-structure to physical factors. *Trans. Am. Microsc. Soc.* 26: 19-102. 9 pls. 1905.

⁵⁹ Solereder, H. *Syst. Anat. Dicotyledonen*. 911. 1899.

In the leaf laticiferous tubes occur only in the veins, and in no case were they observed among the cells of the parenchyma.

Inflorescence.—The inflorescence of *Apocynum* is a trichasial cyme, varying greatly in size, shape, and construction. A cyme may produce but one to four flowers in some cases, while in others the flowers may be extremely numerous. In certain species, as in *A. cannabinum*, where the inflorescence is usually dense, each

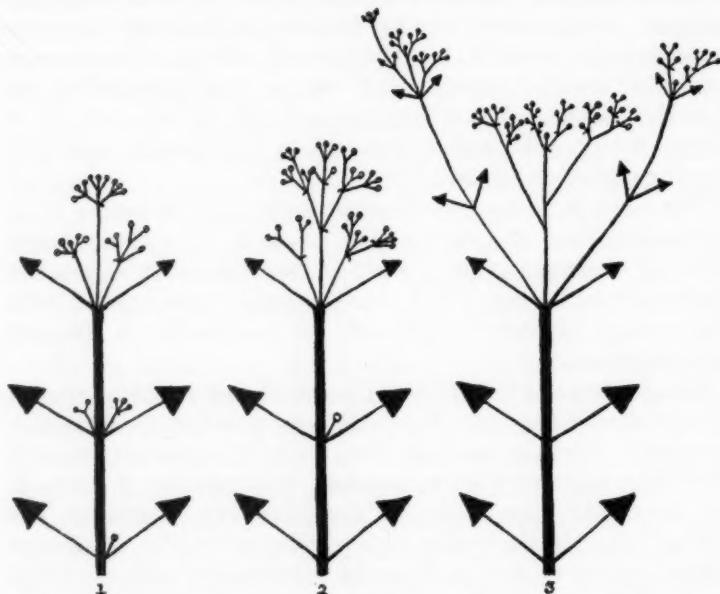


Fig. 9. Diagrams illustrating three characteristic inflorescences among species of the genus *Apocynum*: 1. *A. pumilum*; 2. *A. androsaemifolium*; 3. *A. cannabinum*.

pedicel and peduncle is subtended by a distinct bract which may be scarious, as in *A. cannabinum* and its varieties, or semifoliaceous, as in *A. hypericifolium* and its varieties. In the case of others, as *A. androsaemifolium* and its allies, where the cymes are fewer-flowered, pedicellar bracts may be evident or virtually lacking.

Text-fig. 9 illustrates very diagrammatically the three most prominent forms of inflorescence from which all other forms in the genus appear to be derived. Diagram 1, representing the

inflorescence of *A. pumilum*, shows the inflorescence to be chiefly terminal, but evidently axillary also in decreasing quantities along the upper nodes of the stem, receding from a multiparous cyme, usually composed of three fully developed cymes, to uniparous axillary cymes in the axils of the upper leaves (which are usually somewhat reduced in size), and finally to single axillary flowers subtended by leaves of normal size.

The first diagram demonstrates that the central cyme of the pleiochasm is the most extensive and perfect in form, branching regularly and determinately. The ventral terminal branches, however, are less extensive, and evidently less regular than the dorsal, demonstrating a suppression of the determinate flower or cymule. Finally, the small axillary cymes are found to continue this suppression until the inflorescence is reduced to a single flower, and later disappears altogether.

Diagram 2, representing an inflorescence of *A. androsaemifolium*, illustrates the subsequent continuation of the tendencies noticed in the inflorescence of *A. pumilum*. The central cyme of the terminal pleiochasm is here also seen to be the most elaborate of the three branches of the trichasium, and nearer to the determinate type; but here, in its ramifications, is again noticed the suppression of the determinate member of the cyme, the central cymules being reduced as a rule to a single flower, and the central flower of the cymule frequently suppressed. The tendency toward the development of the paniculate type is shown by the two ventral cymes of the trichasium, where the determinate character has practically disappeared. Axillary flowers or cymules appear only abnormally.

Diagram 3 represents an inflorescence of *A. cannabinum*, where the tendencies noted in the preceding paragraphs find final amplification. Here the inflorescence has become a paniculate cyme, and axillary flowers are completely suppressed. The determinate character is also wanting, except theoretically in the triple multiplication of the terminal pleiochasm. Here also it is found that one of the lateral cymes of the trichasium, or not infrequently both of them, has acquired the power to continue vegetatively to form a new and complete stem with a terminal trichasium, and thus to continue and prolong the re-

productive potentialities of the plant. In this manner a plant of *A. cannabinum* and its allies may continue in bloom and vegetative growth from spring until late in the autumn, a distinct advantage over the much shorter periods of growth of the other species.

A condensed view of the tendencies of the inflorescences illustrated appears to be to regard the entire process as the building up of a compact, specialized form from a branch of axillary flowers through the reduction of foliage and the aggregation of flowers. From such a viewpoint, it would be reasonable to regard *A. pumilum*, with a nearly perfect determinate cyme and normal axillary flowers, as the most primitive of the types discussed; *A. androsaemifolium*, with a less determinate cyme and abnormal axillary flowers, and *A. hypericifolium*, with paniculate cymes, foliaceous bracts, and no axillary flowers, as intermediate types; and *A. cannabinum*, with a paniculate cyme, scarious bracts, and no axillary flowers, as the most advanced.

Flowers.—The floral anatomy of the genus *Apocynum* has already been described in some detail (pp. 25-30). In this section the separate organs will be discussed in a general manner, only.

The calyx of *Apocynum* is synsepalous. The five regular lobes are separate almost to the base, and may be greenish, reddish, or whitish in color, and pubescent or glabrous. It appears that the ecological situation of the plant has much to do with the pigmentation of the vegetative parts, including the calyx; an exposed sunny situation almost invariably imparting a ruddy tint to those parts.

The lobes of the calyx vary considerably in outline; and the margins are entire, save in one variety, *A. medium* var. *lividum*, where they are minutely laciniate or toothed.

The corolla is gamopetalous and regularly five-lobed. Contrary to the opinion of several students of the genus, the shape of the lobes appears of little taxonomic importance. The position of the lobe with reference to the corolla-tube, however, appears dependable. In *A. androsaemifolium* and its allies, the corolla-lobes are sharply recurved, differing distinctly from those of *A. cannabinum* and its allies, which are nearly, or quite, erect. The lobes of *A. medium* and its varieties add an additional inter-

mediate character to their striking affinities to both the andro-saemifolioid and the cannabinoid groups by assuming a spreading position. The color of the corolla varies from greenish white to pinkish or purplish.

The relative length of the corolla and the calyx-lobes has proved to be an important taxonomic criterion. In *A. androsaemifolium* and its allies, the ratio of the length of the corolla (including both tube and lobes) to the length of the calyx lobes is at least 3 : 1. In *A. cannabinum* and its allies, the same organs have a ratio of less than 2 : 1, and the calyx-lobes usually equal the corolla in length. In *A. medium* and its varieties, the ratio of corolla to calyx-lobes is almost exactly 2 : 1. The comparative width of the corolla at base and orifice is an additional character which is frequently used. In *A. androsaemifolium*, the tube of the corolla dilates considerably, and the orifice is much wider than the base, producing a campanulate flower. In *A. pumilum*, the corolla is cylindrical, and the base and the orifice are nearly or quite equal. So also the corolla-tube of the typical variety of *A. hypericifolium* is somewhat campanulate, while that of *A. hypericifolium* var. *salignum* is nearly cylindrical. The corolla is preponderantly glabrous throughout the genus, but very rarely, as in *A. medium* vars. *sarniense* and *vestitum*, microscopic tufts of tomentum are developed upon the exterior.

The cellular constitution of the corolla is illustrated by a sector of a cross-section in pl. 6, fig. 1. As illustrated in the figure, the most characteristic feature of the corollar anatomy is the external epidermis of a single layer of bulbous, or papillate cells. It is a further elongation of these protuberant cells which causes the peculiar and characteristic pulverulent-papillate condition of the corollas of *Poacynum* and *Trachomitum*, as well as the microscopic tomentum of the corollas of *Apocynum medium* vars. *sarniense* and *vestitum*.

The mesophyll of the corolla is relatively thick, and is composed of large, irregular, loosely connected cells. Latex tubes are numerous, but do not appear to be associated with the conductive system as in the leaves and to some extent in the calyx-lobes. Fifteen vascular strands enter the corolla, after it is fully differentiated from the receptacle, assuming five groups of three

strands each. These vascular groups correspond to the lobes of the gamopetalous corolla, and are homologous to petals. In the neighborhood of the median vascular strand of each lobe, the cells of the mesophyll are smaller and more compact than elsewhere. This region is occupied by the peculiar corollar flanges characteristic of the genus. These flanges are composed of three internal ridges at the base of the corolla-tube which gradually converge into a tiny apiculate tip, forming a flat cordate-sagittate process about 2 mm. tall and 1.5 mm. broad, which alternates with the stamens, the apex fitting closely into the spaces between the auricles of the anthers. Conjectures concerning the significance of these corollar flanges were offered in a previous section of this study; their function will be discussed subsequently. Plate 6, fig. 1, illustrates the transverse constitution of the three corollar flanges at slightly different levels. Text-fig. 10, diagram 2 (g), presents their superficial habit.

The stamens are very highly developed, and sterilization of tissue is apparent. They are rather loosely attached to the base of the corolla-tube, alternating with the lobes. The filaments are short and thick, and frequently very pubescent. The anthers are introrse, connate, and appressed about the pistil in the form of what has been described as a "gynostegium" by Demeter,⁶⁰ who wished to emphasize an analogy with a somewhat similar condition in the Asclepiadaceae.

The anthers consist largely of a greatly elaborated, sterile, peltately affixed, narrowly sagittate connective, with a deeply auriculate base. The four small sporangia are borne above the insertion of the filament. The basal, or auriculate, half of the anther is completely sterile. At the maturity of the pollen, or shortly before, the partition between each of the dorsal and ventral loculae is ruptured, giving the appearance of a two-celled anther. Finally the ventral cells dehisce longitudinally and shed the pollen. The false bisporangia of *Apocynum* are characteristic of the genera of Apocynoideae, and appear to constitute an additional affinity with the Asclepiadaceae.

The pollen grains are relatively small (diam. about 10 μ), spherical, and smooth-walled. The pollen tetrads, as has already

⁶⁰ Demeter, K. *I. c.* 1922.

been explained, never normally separate into individual grains. The pollen of practically all the species of *Apocynum* is largely abortive, and polysporous tetrads are frequent, apparently indicating frequent hybridization.

Upon the receptacle are situated the two carpels comprising the ovary and the cycle of five fleshy nectaries which encircles them. The carpels are separate except by their common partial immersion in the receptacle, and at the tips, where they are united by a common fleshy style called the clavuncle. The clavuncle is thickened and truncate, and bears the terminal stigma. Plate 6, fig. 3, illustrates the cellular condition of a median longitudinal section of the clavuncle of *Apocynum androsaemifolium*. The organ should evidently be construed as the product of the fusion of two bodies representing the individual style and stigma of either of the two carpels, as the two vascular strands (the dorsal strands of either carpel) present in it are entirely separate, and the body cells themselves retain an individual appearance especially in the central region. The upper, or stigmatic surface of the clavuncle, is highly glandular, and secretes copiously.

During the earlier phases of the present study, the shape of the clavuncle of the various species of *Apocynum* was considered to be of taxonomic importance. Extensive studies of the clavuncle of all the described species and varieties were accordingly made. Many vials were filled with dissected clavuncles, and correctly labelled with the appropriate taxonomic designations. Micro-photographs were also made in the hope that they would provide a concise criterion for differentiation. After several months of concentration upon that organ alone, however, the conclusion was reached that the clavuncle is apparently quite variable, and of doubtful taxonomic assistance. Other technical characters have likewise been exhaustively studied to aid in the delimitation of species, but their value has appeared so dubious that in the taxonomic treatment which follows, macroscopic characters have been employed in entirety. Dr. Ballard,⁶¹ however, has employed the character of the clavuncle in providing a survey of the species of the eastern United States for pharmaceutical use.

⁶¹ Ballard, C. W. Taxonomy and pharmacognosy of the genus *Apocynum*. Proc. Internat. Cong. Plant Sci. 2: 1406-1412. 1929.

Either carpel of the gynoecium contains a single loculus bearing numerous anatropous ovules upon an axile binate placenta. The placenta contains two main longitudinal vascular bundles from which the traces to the ovules depart.

A common misconception regarding the Apocynaceae is that the nectaries which frequently surround the carpels represent a "disc." Such, however, is not the case, unless the term "disc" is to become an entirely meaningless shibboleth. The nectaries, as has already been observed, are probably developments of a vestigial cycle of carpels. Detailed evidence has already been presented to support the assertion that they should be viewed

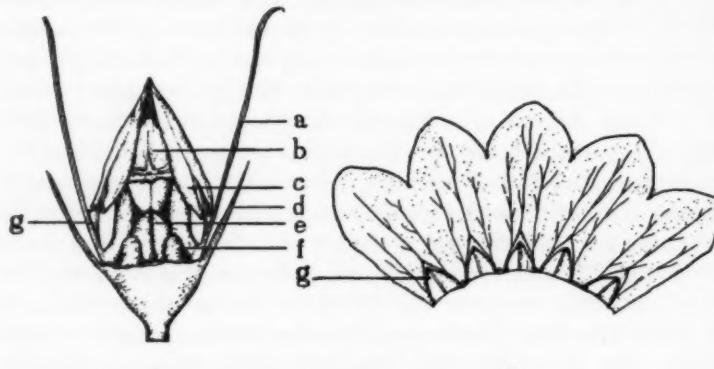


Fig. 10. Floral morphology of *Apocynum androsaemifolium*. 1: longitudinal view, with portion of corolla removed. a- corolla; b- clavuncle; c- stamen; d- calyx; e- ovary; f- nectary; g- corollar appendage. 2: interior of dissected corolla, indicating the corollar appendages, g.

as equivalent to a cycle of carpels. However, the nectaries occasionally demonstrate a coalescence with the receptacle (cf. *Odontadenia*), or even with the carpels (cf. *Tabernaemontana*), when their status naturally becomes obscure. Text-fig. 10 illustrates the organography of the flower of *A. androsaemifolium*.

Floral Mechanism.—The floral organs of the genus *Apocynum*, which have been separately described in the preceding paragraphs, compose a reproductive mechanism of extreme interest, but one which has never yet been satisfactorily explained.

As will be seen from a glance at text-fig. 10, diagram 1, the four

cycles of reproductive organs form an intricate and compact mass within the center of the perianth. Without careful dissection and keen observation the parts and composition of the complex mechanism are scarcely easy to comprehend. The center, of course, is the bicarpellary gynoecium (*e*) surmounted by the barrel-shaped clavuncle (*b*). As will be perceived from the diagram, the clavuncle is divided equatorially into an upper and a lower region. The upper region is slightly bilobate, and was considered by Linnaeus and Tournefort to bear the stigma.

Pressed tightly about the clavuncle and gynoecium is the cycle of five stamens (*c*) alternating with the ovoid nectaries (*f*) and the sagittate corollar appendages (*g*). The anther of the stamens is fertile only toward the apex (i. e., the portion adjacent to the upper half of the clavuncle). At the point of attachment of the filament to the anther, elongate glandular hairs arise from the epidermis and meet with similar epidermal outgrowths from the equatorial region of the clavuncle. These elongate cells secrete viscin, which binds the androecium to the gynoecium. So tightly are the two cycles of sex organs cemented by these epidermal appendages and their secretions that one can scarcely remove the stamens without dislodging the clavuncle from the apex of the carpels.

The true position of the stigmatic surface and the procedure of the pollination of *Apocynum* have been much and variously discussed. As has been stated above, the stigma was called terminal by Linnaeus and Tournefort, neither of whom attempted an explanation of its pollination. In 1759 Fabricius⁴² wrote of the attraction which *A. androsaemifolium* exerts upon nectar-loving insects and observed that frequently the visitors are found trapped within the flower. In 1783 Lamarck⁴³ described the insect relations of the same species as follows:

"The name *gobe-mouche* [fly-trap] has been given to it, because the flies, in their greed of the honeyed juice which is found at the bottom of its flowers, insinuate their proboscides by the narrow passage which is found between the small bodies [nectaries] which surround the ovaries, and the ovaries themselves, and when the insects would withdraw their proboscis, it is found to be held the faster, the more efforts they make to withdraw it. Thus these insects, half buried in the flowers, are caught as in a trap, and perish there without the power to escape."

⁴² Fabric. Enum. Meth. Pl. 256. 1759.

⁴³ Lam. Encycl. 1: art. *Apocynum*. 1783.

In Europe, *A. androsaemifolium* was cultivated since early days, the exact date of its introduction being unknown.⁶⁴ However, by the last quarter of the eighteenth century it was evidently widely cultivated and viewed as a curiosity because of its propensity of capturing insects. In 1794 Moench⁶⁵ proposed the name *A. muscipulum* for *A. androsaemifolium*.

Although it is now fully understood that insects trapped in flowers of *Apocynum* are probably always detained by the viscous floral secretions, some fantastic explanations have been advanced. Lamarck⁶⁶ was of the impression that mechanical pressure exerted by the nectaries is responsible for detaining the proboscis. A somewhat more current view was that the anthers actually grasped the insect as do the leaves of *Dionaea*. Erasmus Darwin⁶⁷ appears to have been one of the first to sponsor this view, and wrote as follows:

"In the Apocynum Androssaemifolium, one kind of Dogbane, the anthers converge over the nectaries, which consist of five glandular oval corpuscles surrounding the germs; and at the same time admit air to the nectaries at the interstice between each anther. But when a fly inserts its proboscis between these anthers to plunder the honey, they converge closer, and with such violence as to detain the fly which thus generally perishes."

Although accounts of other authors regarding the muscipulous habit of *Apocynum* would not be suitable in this general account, the description of the plant by the anonymous author of 'The Journal of a Naturalist'⁶⁸ should be included as perhaps the most fabulous of all:

"But we have one plant in our gardens, a native of North America, than which none can be more cruelly destructive of animal life, the dogbane (apocynum androsaemifolium) which is generally conducive to the death of every fly that settles upon it. Allured by the honey on the nectary of the expanded blossom, the instant the trunk is protruded to feed on it, the filaments close, and catching the fly by the extremity of its proboscis, detain the poor prisoner writhing in protracted struggles until released by death, a death apparently occasioned by exhaustion alone; the filaments then relax, and the body falls to the ground. The plant will at times be dusky from the numbers of imprisoned wretches. This elastic action of the filaments may be conducive to the fertiliza-

⁶⁴ Ray (Hist. Pl. p. 1089) mentions "Apocynum flore Lili convallium purpurascente" as appearing in the famous physic garden at Chelsea in 1688.

⁶⁵ Moench, Meth. 464. 1794.

⁶⁶ Lam. l. c. 1783.

⁶⁷ Darwin, E. The botanic garden. Part 2: The loves of the plants. 126. 1791.

⁶⁸ Anon. The journal of a naturalist. 80-81. 1829.

tion of the seed by scattering the pollen from the anthers, as is the case of the berry; but we are not sensible, that the destruction of the creatures which excite the action is in any way essential to the wants or perfection of the plant, and our ignorance favours the idea of wanton cruelty in the herb; but how little of the causes and motives of action of created things do we know!"

This highly fictitious narrative is illustrated by a sketch showing the flower of *A. androsaemifolium* before: with outspread anthers awaiting the visit of the victim; and after: with the anthers pressed tightly about a fly.

Apparently the first man to interpret the visits of insects to *Apocynum* as a means of pollination was Bartolozzi,⁶⁹ who advanced the opinion that the visiting insects inject the proboscis between the connate mass of the clavuncle and anthers both to obtain the pollen and to apply the pollen to the stigma. The account of Bartolozzi regarding the insect visits and the morphology of the flower was an exceptionally full and accurate one for its day.

In 1809, as is well known, Robert Brown⁷⁰ described the stigmatic surface of *Asclepias* as occupying the lower portion of the stylar shaft, and succeeded in tracing pollen tubes from that organ to the placenta and ovule. Contemporaneous botanists were quick to accept Brown's observations, and in 1849 Schleiden⁷¹ also drew the conclusion that the stigma of *Apocynum* is situated likewise on the basal half of the clavuncle.

In 1867 Delpino⁷² largely recapitulated the conclusions of Bartolozzi, favoring the view that pollen is transmitted to the basal stigma by the efforts of the proboscis to reach the nectaries surrounding the ovary. During the years 1872-73 W. H. Leggett⁷³ became interested in the biology of *Apocynum*, devoting several short but highly interesting articles to the subject in the 'Bulletin of the Torrey Botanical Club.' Leggett followed Delpino's de-

⁶⁹ Bartolozzi, F. Memoria . . . sopra le qualità che hanno i fiori della piante detta *Apocynum androsaemifolium* di prender le mosche, etc. Opusculi scelti sulle scienze e sulle arti. 193-200. 1779.

⁷⁰ Brown, R. Mem. Wern. Soc. 1: 12-18. 1809.

⁷¹ Schleiden, M. J. Botanik. 494. 1849.

⁷² Delpino, F. Sugli apparechi della fecondazione nelle piante antocarpee . . . 19-21. 1867.

⁷³ Leggett, W. H. Bull. Torr. Bot. Club 3: 46, 49-50, 53-55. 1872; 4: 1-2, 23. 1873.

scription of the pollination of the genus, adding many original observations on the manner in which insects are frequently trapped within the flower.

The manner in which pollen can be transferred to the stigma by the proboscis is easily understood, but the method of acquiring the pollen itself is not so easy to explain, since the insects send the proboscis straight to the receptacle of the flower by way of the exterior of the stamens and not usually through the connate mass of the anthers. This was neatly explained by Leggett as follows:

"The fly probably dips its head down to get at the nectaries in the bottom of the cup, and, in drawing it back, sometimes gets its proboscis caught in the groove between the anthers, to which it is guided by their diverging bases. As the proboscis is drawn up the groove, it passes the glutinous glands [i. e., the viscous secretions from the epithelial gland-hairs of the stamen and clavuncle], which are easily detached when the flower is mature, and, being thus charged with one or both of these glands, draws out the pollen from one or both of the adjacent anther cells. Perhaps alarmed by this rude entertainment, the insect flies off to a more distant flower, where it goes through the same process, first, however, leaving the stranger pollen on the stigmatic surface."

It is evident that all who have dealt with the subject have been put to some pains to explain the pollination of *Apocynum*. By no means a help to the situation is the reassignment of the stigmatic surface to the upper half of the clavuncle by Demeter,⁷⁴ who investigated the cellular constitution of that organ and found the typically stigmatic cells located in that position. Plate 6, fig. 3, represents a median longitudinal section of the clavuncle of *A. androsaemifolium*. It will be seen that the upper portion bears typically glandular stigmatic cells (d), while the lower region is scarcely equipped to carry on the function of a stigma. Pollen tubes have also been found by the writer to penetrate through the upper region of the clavuncle.

As all of the investigators dealing with the subject in recent years have believed, the flowers of *Apocynum* are apparently unable to fertilize themselves. At the present, however, the process of pollination appears almost as much in the dark as ever. It would appear that normal insect visits do not succeed in pollination, and that it is only when a visitor becomes trapped and struggles to escape that the floral mechanism is disarranged

⁷⁴ Demeter, K. I. c. 1922.

sufficiently to allow the reception of the pollen by the stigma. At any rate, fertilization is truly a phenomenon in the genus, for follicles are relatively rare.

In 1891 Robertson⁷⁵ compiled an extensive series of notes regarding the visits of insects to native flowers. His list of insect visitors to *Apocynum cannabinum* includes nineteen species of Hymenoptera, seventeen species of Diptera, two species of Lepidoptera, one species of Coleoptera, and two species of Hemiptera.

Fruit.—The fruit of the genus *Apocynum* is a pair of elongate, terete follicles. The distinctness of the two is marked, save in very early stages when they may be united at the tips. The short union at the tips, however, is responsible for a taxonomic character which has been used occasionally in the delimitation of taxonomic units. This character is a falcate appearance caused by unequal growth of the follicles when united at the tips, producing a gibbous condition.

The follicles are usually pendulous, but are erect in *A. pumilum* and its variety *rhomboideum*. This character, in the light of what has been previously written concerning the inflorescence of *A. pumilum*, might lead one to the thought that possibly the pendulous follicles of the other species represent a modification from a primitive erect condition.

The seeds are abundant, linear-terete, and abundantly comose at the micropylar end. The coma develops from the superficial cells of the outer integument which elongate into a sessile whorl. The seeds possess but a single integument, and the nucellus, composed of but a single layer of cells,⁷⁶ is evanescent. An endosperm, likewise, is absent from the mature seed. The length of the seed and coma is occasionally used as a taxonomic criterion in the revision which follows. At maturity the placenta withers away, leaving the follicle filled with free seeds which are easily dispersed by the wind upon dehiscence.

The embryo is straight, and typically dicotyledonous. Plate 4, fig. 5, represents the habit of the embryo of *Apocynum hypericifolium* magnified about twenty-five diameters. The embryo itself

⁷⁵ Robertson, C. Bot. Gaz. 16: 70-71. 1891.

⁷⁶ Frye, T. C., & Blodgett, E. B. Bot. Gaz. 40: 51-52. 1905.

is shuttle-shaped, the two fleshy cotyledons equaling about one-half the length of the body. The radicle is differentiated from the hypocotyl as an abruptly bevelled point. The plumule is not differentiated in the seed.

The vascular element of the embryo in the dormant seed is limited to procambium. It is not until the plumule is formed in the seedling that the normal vascular constitution is evident. The cells of the embryo are rich in protein and starch, although the latter is concentrated chiefly in the cotyledons. Latex inclusions are present only within cells similar in all other respects to the normal parenchyma. Such latex cells are infrequent.

Laticiferous System.—The Apocynaceae as a family are popularly notable chiefly because of the internal secretory system which occurs in all genera. The internal secretions, or latex, may be colorless, greenish, most frequently whitish, and rarely somewhat ochraceous. In the genus *Apocynum* the latex is chalky white, viscid, and coagulates spontaneously.

The latex of the genus *Apocynum*, as evidently throughout the family Apocynaceae, is contained in extensive cells which ramify nearly the entire plant. A few organs, notably the young absorptive roots and the anthers, are evidently without latex cells.

In the embryo, the initials of the latex cells first appear in the plane which coincides with the node of the cotyledons.¹⁷ In the embryo of the fully mature seed, they are observed in the cotyledons which resemble the fundamental cells except in their contents. At such a stage, the hypocotyl does not usually appear to contain latex cells. Later, during the seedling stage, they extend to the hypocotyl as well as to the plumule.

In young absorptive roots, as has already been stated, latex tubes are lacking, or rare (pl. 4, fig. 1). In older roots, especially the gemmiferous roots, they occur freely, apparently being confined to the cortex in the majority of cases (pl. 4, fig. 2*h*). In the rhizome and stem they are apparently confined to the pericycle, where they are intimately associated with the pericyclic fibers (pl. 5, figs. 1-3 *j*). In some cases, particularly in young stems, however, isolated tubes are found in the outer layers of the pith (pl. 5, figs. 1-2 *m*). In the leaves, the laticiferous tubes are apparently restricted to the vascular bundles.

¹⁷ *cf.* Chauveaud, G. Ann. Sci. Nat. Bot. VII. 14: 108-109. 1891.

In the calyx, as in the leaves, the latex tubes are evidently associated with the vascular bundles. In the other floral parts, the corolla, the stamen filaments, and the gynoecium, including the nectaries, they ramify chiefly the non-vascular tissue (pl. 6, figs. 1c, 2d, and 3c; also pl. 3, fig. 4).

The latex of *Apocynum* contains suspended proteins, starch, and crystalloids, and yields over 2 per cent caoutchouc. The economic possibilities of the caoutchouc will be discussed in a subsequent section of the present study. The latex cells are evidently coenocytic.

INTRA-GENERIC RELATIONSHIPS

In the case of a genus so complex and difficult as *Apocynum*, it is manifestly impossible to submit a taxonomic revision immune to much justifiable criticism. In the opinion of Asa Gray, the total number of the species of *Apocynum* was two. His younger contemporary, Edward L. Greene, of an entirely different viewpoint in matters taxonomic, himself published over fifty species of the genus, and left herbarium names upon nearly a score of specimens in the United States National Herbarium and the Greene Herbarium at Notre Dame University.⁷⁸ Most of the Manuals and Floras which have dealt with the genus have fortunately striven to strike a mean between these two extremes, but frequently with a result which reflects the authors' uncertainty.

The specific concept in the present work is largely one of practical application. The watchwords have been qualitative constancy and geographical unity. Above all, the paramount necessity of a workable key has been recognized and supplied to the best of the author's ability. In taxonomic work the key is frequently, as indeed it should always be, the essence of the author's conception of his problem; and by his keys a taxonomist's work is most frequently liable to judgment.

In this revision, a key to all the species and varieties of the genus *Apocynum* is offered for the first time. Among the deficiencies of the monograph by Béguinot & Belosersky,⁷⁹ one of

⁷⁸ It is unfortunate that a considerable number of Greene's herbarium names were published as *nomina nuda* in the synonymy of Béguinot & Belosersky's monograph.

⁷⁹ Bég. & Bel. l. c. 1913.

the most conspicuous is a complete lack of keys or any other analytical differentia. This lack renders the work not only extremely ambiguous, but of little use to the botanical public.

From a glance at the Key to the Species which follows, it will be seen that the genus is roughly divisible into two groups, namely, species with drooping or spreading foliage and corolla at least twice the length of the calyx-lobes; and those with ascending foliage and corolla barely longer than the calyx-lobes. Within the first category there are two subdivisions: species with drooping leaves and corolla at least thrice the length of the calyx-lobes; and species with leaves spreading or rarely (*A. Suksdorffii* and *A. Jonesii*) ascending and corolla about twice the length of the calyx-lobes. The second category is divided into a group with leaves evidently petioled, narrowed at the base or the very lowest obtuse and subsessile; and a group with leaves mostly cordate or obtuse and sessile, especially below. Roughly, these four unnamed divisions correspond with Béguinot & Belosersky's sections "Androsaemifolii," "Medii," "Cannabini," and "Hypericifolii," with which those authors sought to subdivide the genus.

A study of the plants in the field, however, shows that there are no sharp lines of cleavage in the genus, and that the division of the genus into named sections is both unnecessary and artificial. It is found upon close study, even in the herbarium alone, that the species are so confluent as to make sectional lines extremely obscure. The cause of this specific intergradation, it is believed, is due to mass mutation through hybridism.

Evidently the flowers of all species of *Apocynum* are self-sterile, for otherwise they would yield theoretically 100 per cent fruit, since the anthers press so closely about the stigma that self-pollination is unavoidable. As a matter of fact, however, relatively few flowers are actually fertilized, say 10 per cent at most, which bespeaks the presence of another agency than the mere dropping of the pollen upon the stigma of the same flower. In the summer of 1928, bagging experiments were conducted in experimental plots of the Missouri Botanical Garden and in the field with evidence supporting the assumption of self-sterility. In the succeeding season efforts were made to self-pollinate *A. cannabinum*, with negative results.

It appears probable that through the glandulosity of the clavuncle, cross-pollination is effected by insects freeing the stigmatic surface of the flower in a violent attempt to reach the nectar secretions, thus allowing the subsequent cross-pollination by the same, or another visitor. The violence and frequency of insect visits to the flowers of *Apocynum* is attested by the numerous flies which are found trapped in them.

Lotsy,³⁰ the greatest exponent of the theory of the origin of species by hybridization and mass mutation, summarizes his observations as follows:

"It was, to my way of thinking, the coming into the world of sexual reproduction, not response to stimuli, which made evolution possible. I may also express this so: that the difference is a double one, in as much as the theory of hybridization not only substitutes crossing for variability as the cause of evolution, but also considers those groups of individuals which systematists call species as mere remains of formerly very diverse swarms arisen from a cross, and not as the progeny of a single individual or two individuals, which, except in sex, were alike."

Without attempting to insert here a criticism of Lotsy's theories, especially with regard to the logical consequences of substituting *in toto* variations by hybridization for the infinitely slower accumulation of Darwinian variations, let it suffice to say that with regard to the genus *Apocynum*, the theories of Lotsy can be very favorably applied.

Reasons for assuming that the species of *Apocynum* are self-sterile and depend largely upon cross-pollination for sexual reproduction have already been given from a mechanical viewpoint. The obvious result of extensive hybridization, mass mutation, is found on every side by those who are willing to study the plant in the field. Clearly, in the case of *Apocynum*, the plants intergrade to such an extent that the taxonomist may well be led to agree with Lotsy that species arise by swarms and the subsequent falling out of the intermediates to form more or less isolated entities. Conservative botanists must allow great variability if they acknowledge a small number of species; others can recognize in the place of specific variability a large number of distinct species, as did Greene.

³⁰ Lotsy, J. P. Evolution considered in the light of hybridization, p. 59. Christchurch, N. Z. 1925.

Field observations have been a frequent source of information throughout the course of these studies; and in the case of the suspected hybridism of the genus they have apparently shed much light. Upon several occasions, notably in Indiana and Colorado, the hypothetical hybrids and the suspected parents have been found growing intermingled or in adjacent areas. In the summer of 1928, in company with Dr. J. A. Nieuwland of Notre Dame University, and upon another occasion with Dr. Edgar Anderson of the Missouri Botanical Garden, the writer visited a field at Notre Dame in which *A. androsaemifolium*, *A. cannabinum*, *A. hypericifolium*, and *A. medium* were abundant. Early in September, when the field was last visited, there was abundant fruiting material of the first three species; none, however, was apparent of *A. medium*. During the summers of 1927-29, field studies were made in the state of Colorado. At several points varieties of *A. medium* were discovered in areas adjoining one or both of the suspected parent species. Sterility of the hypothetical hybrid was always conspicuous.³¹

Near Bayfield, Colorado (see also p. 48), thousands of plants of *A. medium* var. *lividum* were discovered infesting a field of about fifty acres in extent. Throughout the entire field (pl. 8) not a single indication of fructification was found upon examination. Near Lyons, Colorado, the same variety was discovered in clones of several hundreds of plants each. No fructification was visible, although plants of *A. androsaemifolium* var. *incanum*, just across the road, and *A. hypericifolium* var. *salignum*, nearby, supposed to be the parents of the hybrid, provided abundant fruiting specimens.

At the base of Eagle Cliffs, in Moraine Park, Colorado, there exist intermingled clones of *A. androsaemifolium* var. *incanum* and *A. medium* var. *floribundum*. This particular location was visited in 1927 and again in 1929; and in neither year was fruiting material observed upon the *A. medium*, although follicles

³¹ It is not meant to convey the impression that necessarily *all* of the supposedly hybrid species and varieties are absolutely sterile, however. The common eastern, or typical, variety of *A. medium* frequently produces follicles, and for that reason, as well as for its abundance and wide distribution, might be regarded as of earlier origin than the more restricted and apparently sterile western varieties of the same species.

were borne on *A. androsaemifolium*. This location is especially interesting because of the fact that in 1929 one small plant was found in flower which was strikingly intermediate between the two species. This plant is described as *A. androsaemifolium* var. *intermedium* in the taxonomic section which follows. The foliage of this plant is similar to that of *androsaemifolium*, but the flowers are strikingly intermediate, since, although the corolla-tube is cylindrical and only about twice the length of the calyx-lobes as in *A. medium* var. *floribundum*, the lobes are recurved as in *A. androsaemifolium* var. *incanum*. Statistically, the external measurements of the flowers of the three varieties growing at Eagle Cliffs are as follows; the figures are in millimeters:

	<i>A. androsaemifolium</i> var. <i>incanum</i>	<i>A. androsaemifolium</i> var. <i>intermedium</i>	<i>A. medium</i> var. <i>floribundum</i>
Length of corolla-tube, including the limb	6.5-7.5	4.5-5.5	3.5-4.0
Width of the corolla-tube at base	2.0-2.5	3.0-3.5	1.5-2.0
Width of the corolla-tube at orifice	5.0-6.5	3.0-3.5	1.75-2.0
Length of the calyx-lobes	1.0-1.25	2.0-3.0	2.0-2.5

Naturally, it is appreciated that in order to firmly substantiate the hypothesis of the speciation of *Apocynum* through hybridization, cytological studies should be made of each species, especially with regard to meiosis in the pollen-mother-cells. Unfortunately, however, the cytology of *Apocynum* presents serious difficulties. The formation of the tetrads occurs at an extremely early stage in the formation of the bud, young buds in which the stamens are mere filaments less than a millimeter in length invariably being found to contain tetrads. When one remembers that the sporangia occupy only about one-eighth of the mature stamen, the difficulty of the problem may be appreciated. The omnipresent latex also offers difficulties in killing and fixing. Since the primary object of this monograph is taxonomic and morphological, therefore it was decided to defer attempts at a cytological study.

However, certain cytological characteristics of hybrids are deducible through morphology. One of the most easily perceived of these is the irregular division of pollen-mother-cells producing polycary and polypory through the independent organization of lagging univalent chromosomes. Of course hybridization may occur without such chromosomal incompatibilities or other phenomena may produce them, but the work of Rosenberg⁸² on *Drosera* and other genera, and the work of Jeffrey⁸³ and others, have demonstrated clearly that hybrids can usually be detected through observation of the meiotic divisions of the pollen-mother-cells, and therefore by an examination of mature pollen, since hybrids very frequently betray the nature of their origin through the production of sterile and polyporous pollen.

Accordingly studies of the pollen of the species of *Apocynum* were made, both in the fresh state and in microscopic preparations. Since the pollen grains are held permanently in tetrads throughout the genus, polypory can easily be detected in the forms which exhibit it. A certain amount of sterile pollen was evident in all of the species, and polyporous tetrads were found in others. The results may be summarized by stating that the four classic species of *Apocynum* (*A. pumilum*, *A. androsaemifolium*, *A. hypericifolium*, and *A. cannabinum*) have the smallest percentage of sterile pollen and that the intermediate species and varieties have a greater sterility. These findings are in accord with the taxonomic arrangement of the species in this monograph.

With the combination of taxonomic, morphological, and distributional observations, a phylogenetic chart has been prepared which illustrates, from the author's point of view, the speciation of the genus. Such visualizations are doubtless extremely liable to equivocation, but furnish a certain intellectual fascination which at times has led to deductions of value.

Text-fig. 11 is a phylogenetic chart illustrating the supposed speciation of the genus *Apocynum* through the hybridization of four potential ancestors. A few words of explanation and interpretation should perhaps be added. The broken lines present the

⁸² Rosenberg, O. Cytologische und morphologische Studien an *Drosera longifolia* \times *rotundifolia*. Kgl. Svenska Vet.-Akad. Handl. IV. 43: 3-64. 1909.

⁸³ Jeffrey, E. C., and Hicks, G. C. The reduction division in relation to mutation in plants and animals. Am. Nat. 59: 410-426. 1925.

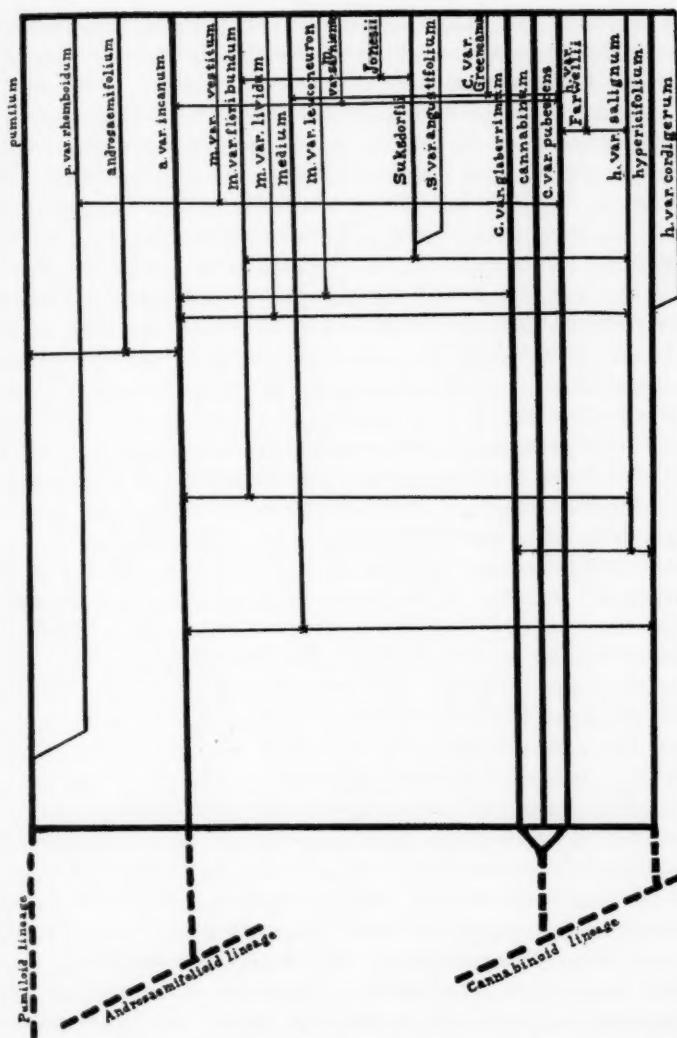


Fig. 11. Phylogenetic chart of the genus *Apocynum*. Explanation in text.

hypothetical rudiments of the genus; the solid lines, the supposed relationship of the known species and varieties. The length of the vertical solid lines indicates the supposed age of the species.

and varieties; the thickness indicates their relative abundance. It will be noticed that of all the species and varieties diagrammed, only six continue straight to the ground-line. These species and varieties, *A. pumilum* (typical glabrous variety), *A. androsaemifolium* var. *incanum*, *A. cannabinum* and its two varieties, and *A. hypericifolium* (typical variety), are those whose origin cannot be hypothesized from any other existent forms, and which are apparently coeval. Of the other species and varieties, only three (*A. pumilum* var. *rhomboideum*, *A. Suksdorffii* var. *angustifolium*, and *A. hypericifolium* var. *cordigerum*), which are merely foliage varieties, are not suspected to be of hybrid origin. Hybridity is indicated by a connecting horizontal line, between the vertical lines of the two supposed parents, upon which is imposed a vertical line of length and thickness proportional to the relative abundance and suspected age of the species or variety.

Four species are considered older than the others, and are diagrammed as such. They fall naturally into three groups, which have been named for the sake of convenience. The first group, designated as the "pumiloid lineage" contains a single "primeval" species. This group is characterized by corollas thrice or more exceeding the calyx, drooping foliage, mostly alternate branching, and above all, by the erect, or nearly erect position of the follicles. The second group, the "androsaemifolioid lineage" likewise contains a single primeval species, and differs from the preceding group chiefly in the position of the follicles, which is decidedly pendulous. The third group, or "cannabinoid lineage" contains two primeval species which are characterized by corollas barely exceeding the calyx, erect or ascending foliage, opposite or subopposite branching, and pendulous follicles. Species and varieties having follicles which are strikingly intermediate between the erect and the pendulous, corollas about twice exceeding the calyx, and spreading (*i. e.* neither drooping nor ascending) foliage, are considered as indicating a nature intermediate between two of the three groups, and are diagrammed as hybrids upon the chart. Species and varieties characterized by the intermediate foliage and flowers moreover display in addition alternate branching by means of the abortion of an opposite branch-bud, an intermediate character of significance.

In constructing the chart, attention has been paid the geographical distribution of the species and varieties as well as their morphology. Instances of such use of geography are *A. pumilum* var. *rhomboideum* and *A. medium* (typical variety). *A. pumilum* var. *rhomboideum* is taken as an offshoot of *A. pumilum* (typical variety) instead of *vice versa*, because the latter has a range extending from the Pacific Coast to the Rocky Mountains, while the former inhabits only the region from the Pacific Coast to the Sierra Nevadas and Cascades. *A. medium* (typical variety) is taken as a product of *A. hypericifolium* and *A. androsaemifolium* var. *incanum* rather than of *A. cannabinum* and *A. androsaemifolium* var. *incanum*, because in Newfoundland and the New England states and adjacent Canada, where *A. cannabinum* is rare or lacking (see pl. 1), *A. medium* is coexistent with *A. androsaemifolium* var. *incanum* and *A. hypericifolium*, which are common species in the above-cited regions.

From an examination of the chart it will be perceived that specific lines in the genus *Apocynum* do not appear very "natural" (i. e., monophyletic). The outstanding example of this feature is the species *A. medium*, the varieties of which are believed to have arisen in different parts of North America from several different crosses between other species of the genus. These varieties, then, although supposedly of no direct relationship to each other, are grouped together as varieties of a single "species" because their taxonomic characters are so similar that, barring the consideration of independent origin by hybridization, they would appear quite like ordinary variations of a "natural" (i. e., monophyletic) species. The geographical distribution of many varieties of the genus appears to support the assumption of speciation through hybridism. For example, *A. medium* var. *sarniense* is known from only three stations: one in Ontario, one in Michigan, and one in British Columbia. *A. hypericifolium* var. *Farwellii* is known from one station each in New York, Michigan, Indiana, and Texas. *A. medium* var. *lividum* has been reported from several stations in Colorado and one station each in Washington and California. Such examples are of frequent occurrence, and together with the morphological and distributional considerations which have preceded, have lent encouragement to the drawing of preliminary conclusions from the mass of circumstantial evidence.

Even if the speciation of the genus through hybridization is disputed or disproved, the chart will serve to illustrate the apparent relationship and relative abundance of the species and varieties plotted. Breeding experiments are now under way to test the veracity of the chart, and it is hoped that within a few years more tangible knowledge than mere external similarities will be forthcoming.

An unfortunate anomaly is discovered in charting the typical variety of *A. androsaemifolium*. Linnaeus³⁴ described *A. androsaemifolium* as *utrinque glabra*. A. de Candolle³⁵ also regarded the typical condition of the species as glabrous, and described the variety with the under surface of the leaves puberulent as *A. androsaemifolium* var. *incanum*. As a matter of fact, the var. *incanum* is to all appearances the primitive condition of the species, and by far the more common, having a range covering nearly that of the genus; while the glabrous or "typical" variety is evidently a hybrid, possibly between *A. pumilum* (typical variety) and *A. androsaemifolium* var. *incanum*, with a range limited to the region west of the Rocky Mountains. Hybridity is suspected between the species suggested because of the campanulate corolla (characteristic of *A. androsaemifolium* var. *incanum*) and complete glabrous (characteristic of the typical variety of *A. pumilum*), but above all because of the erratic follicles (intermediate between the erect follicles of *A. pumilum* and the drooping follicles of *A. androsaemifolium* var. *incanum*). In spite of the probability that Linnaeus could have carelessly described the puberulent leaves of the eastern variety of the species as glabrous, since material from the Rocky Mountain region was scarcely well known to him, the fact remains that he so described them, and the example of de Candolle should be followed in the matter.

The phylogenetic method in Biology, and particularly in Botany, has numerous friends and foes. Hall and Clements,³⁶ continuing the theories of Bessey, have been outstanding in the advocacy of phylogenetic speculation. Crow,³⁷ more recently, has criti-

³⁴ L. Sp. Pl. ed. 1. 213. 1753.

³⁵ A. DC. in DC. Prodr. 8: 439. 1844.

³⁶ Hall, H. M., and Clements, F. E. The phylogenetic method in taxonomy, etc. Carn. Inst. Washington, Publ. 326: 3-31. 1923.

³⁷ Crow, W. B. Phylogeny and the natural system. Jour. Genetics 17: 85-155. 1927.

cized the phylogeneticists helpfully. According to him, phylogenetic Biology has apparently failed in its objective, and he remarks:

" . . . current zoological and botanical literature reflects a loss of interest in phylogenetic research which contrasts strongly with that seen during the immediate post-Darwinian period, but which is obviously not due to the attainment of a fixed scheme of classification."

Continuing further, he observes:

"This state of affairs appears to be the outcome of at least two different trends of investigation. On the one hand, systematists themselves, finding the results of their detailed studies impossible to frame in a simple phylogenetic series, have frequently condensed their results in such a manner that obvious anatomical facts were overlooked, and fantastic interpretations placed on structure, in order to bring the facts into line with a preconceived simple scheme . . . On the other hand, the possibility of formulating a natural system has been challenged by the introduction of Mendelian ideas into heredity. . . It is sufficient here to point out that the criticism by the Mendelian theorists of the older phyletic theorists rests on the assumption that a knowledge of the method of evolution is necessary for the construction of a phylogenetic hypothesis. They agree that if Darwin's view, that gradual variations were chiefly responsible for evolution, was the last word on the subject, then the reconstruction of phylogeny would be possible, but they think they have discovered some new facts regarding the nature of the variations responsible for evolution, and that these facts make phyletic reconstruction impossible."

The statements of Crow in criticism of the older phylogeneticist's methods, it will be noted, are in harmony with the viewpoint adopted in this study. After a prolonged consideration of the problem of species in representative fields of Biology, Crow concludes:

- (1) That the construction of phylogeny is not an arbitrary matter, but depends on certain facts concerning the natural system.
- (2) Phylogeny consists of theories and hypotheses which do not differ in their nature from those of other branches of science. A satisfactory theory of the phylogeny of a group must however state the characters on which it is based.
- (3) Convergence, which has hitherto been urged as one of the greatest objections to phylogeny, is a result of phylogeny and cannot be upheld as an objection to the phylogenetic method.
- (4) Regression, although probably undetected in many cases, is likewise not a real obstacle to phylogenetic research.
- (5) Mendelism and consequent possibilities, even if accepted, do not affect phylogenetic conclusions.
- (6) The confusion of phylogeny with genealogy and the consequent misinterpretation of the aims of phylogeny has led to objections to the phylogenetic method which are without foundation . . . Thus in tracing the phylogeny

of species no account should be taken of the descent of individuals (genealogy) within the species any more than . . . one should take account of purely specific characters in tracing the descent of genera.

(7) The comparison of phylogeny with earlier forms of thought cannot in any way be regarded as an objection to it. Similar comparison can be applied to any branch of scientific thought."

The foregoing quotation from Dr. Crow is given because in a fair degree it coincides with the spirit which dominates this investigation of the Apocyneoideae. However, some dissimilarity, especially in Crow's section (6) of his conclusions should be explained. Contrary to his views, it appears to the author that the importance of individual variation to the specific concept, and the specific variation in turn to the generic concept, especially in the light of evolution by means of hybridization, can scarcely be overestimated. That species arise from individuals, or at any rate from groups of individuals, and genera arise from species, appears to be unavoidable. Thus it appears somewhat illogical to divorce phylogeny from "genealogy," at least in theory, as indeed it is impossible practically to do so.

GEOGRAPHICAL DISTRIBUTION

The genus *Apocynum* is peculiar among the Apocynaceae in being entirely temperate in habitat. Confined to the continent of North America, by far the greatest number of species occurs only within the borders of the United States. All of the species and varieties recognized in this monograph occur in that country, with four species entering the Dominion of Canada, and three reported from Mexico. Three species are also native to Newfoundland. The only region of the United States in which the genus is apparently unknown is peninsular Florida. With its center of distribution in the United States, *Apocynum* finds its northern limit at about the 55th parallel, and its southern limit at about the 30th parallel.

As illustrated by the map in pl. 1 the species of the genus represent a case of progressive endemism. It will be seen that *A. androsaemifolium* and *A. cannabinum* have by far the greatest distribution of any of the species, extending throughout the entire range of the genus. *A. medium*, *A. hypericifolium*, and *A. pumilum* in the order named have the next largest distribution, while

the other species are shown with still more restricted ranges. Of the latter, *A. cannabinum* var. *Greeneanum* and *A. Jonesii* are the most local, each having been reported from a single locality.

The species of *Apocynum* have become as widely distributed ecologically as geographically. Their range of habitat is from saline and fresh water beaches to deep soil and subalpine situations. In general, however, they thrive best in a good field loam, growing with pasture plants with which they furnish lively competition in the struggle for existence. Species growing in such a situation develop robust plants, profusely branched and leaved, and attaining large proportions; while those growing in more extreme conditions are usually reduced in size, and may be sparingly branched and leaved. Plate 7 illustrates a typical clone of *A. cannabinum* var. *glaberrimum* in a cultivated field near Carondelet, Missouri.

Because of their frequency in cultivated fields, certain species have become common in ballast, and have tremendously increased their distribution in that manner. There are few roadsides or railroad right-of-ways in the United States beside which *Apocynum* is uncommon.

In a previous section of this study, reasons were advanced for supposing that hybridization has played a considerable part in the speciation of *Apocynum*. Support for such a view is afforded in a map of the species and varieties (pl. 1) where it is seen that those species and varieties assumed to be of hybrid origin exactly overlap in distribution that of the supposed parent stock.

ECONOMIC USES

The economic uses of *Apocynum* have been numerous and varied. Among primitive peoples it is frequently used as a source of thread and cord, the strong fibres of the plant earning the popular name of "Indian hemp" for *A. cannabinum*. Pickering²² records that Janus Verazzanus, a Florentine mariner sent by Francis I to a "new country westward from Madeira," presumably North America, came upon natives wearing clothing composed of "certe erbe che stavano pendenti a rami degli alberi (*Tillandsia usneoides* L.)" interwoven with "canape silvestra

²² Pickering, C. Chronological history of plants. p. 866. 1879.

(*Apocynum cannabinum* L.)." Fish-nets, bags, and even cloth have also been manufactured from the fibre of the genus by natives of North America. Fibre of *Trachomitum* and *Poacynum* have similarly been employed by the inhabitants of south-central Asia.⁸⁹ A decoction of *Trachomitum* is also used as a tannin by Central Asiatic tribes.

The active principle contained in the plant juices of *Apocynum* is apocynin, a drug which is soluble in both water and alcohol. An injection of apocynin has been shown to have much the same effect as that of digitalin, according to Planchon.⁹⁰ The powder of the root is frequently used in pharmacognosy as a substitute for ipecac.

An indirect economic use of *Apocynum* is found in the western United States, where fields are allowed to become crowded with the plants as a source of nectar for honey-bees.

Recently the economic potentialities of the latex and fibre of *Apocynum* have been demonstrated. As early as 1912 the abundant latex content of *A. androsaemifolium* was declared to be a neglected source of rubber by Fox,⁹¹ who found the rubber content of the latex of that species to be 2.36 per cent. The rubber was found to coagulate spontaneously, and to be yielded in greater quantities from plants grown upon dry sandy soil than from plants growing in agriculturally more desirable land. The natural latex from dry-land *Apocynum* was found to contain 72.29 per cent water, 26.21 per cent solids, and 1.59 per cent ash.

In spite of the favorable demonstration of Fox, little further was done with respect to the economic possibilities of *Apocynum* until during the Great War of 1914-18, when industrial substitutes were in great demand. Accordingly a survey of western North American rubber-producing plants was begun in 1917 as

⁸⁹ [Singer, J.] Flora 54: 222. 1871. "In ganz Sibirien, am kaspischen Meere, in Turkestan, Taschkund und in den Steppen Suedrussland wird der bast von *Apocynum venetum* und *A. sibiricum*, vielfach zu Geweben und Geflechten benutzt. Die auf der nationalen russischen Industrie-Ausstellung in St. Petersburg (1870) vorhandenen Gewebe, aus Suedsibirien eingeschickt, waren schoen glaenzend, fein und weich. Ferner waren auch, Fischernetze, Jaegertaschen und Schuhe aus demselben Stoff vorhanden. Die Faser ist ungemein theilbar, mehr noch als der Flachs, den sie an Weisse und Glanz weit uebertrifft."

⁹⁰ Planchon, C. Produits des Apocynacées. p. 213. 1880.

⁹¹ Fox, C. P. Another Ohio grown rubber. Ohio Nat. 12: 469-471. 1912.

a war-emergency project under the State Council of Defense of California by H. M. Hall and F. L. Long,⁹² and published in 1921 by the Carnegie Institution of Washington.

The results of Hall and Long show that of the 225 species and varieties studied, the species of *Asclepias* and *Apocynum* indicated the greatest promise industrially. Instead of *A. androsaemifolium*, *A. cannabinum* is viewed by Hall and Long as the species most favorable as a substitute rubber plant, and a rubber yield of somewhat higher than 5 per cent was obtained from this species.

Concerning the fibre of *Apocynum*, especially *A. cannabinum*, there appears to be unanimity of approbation from commercial investigators. From both the experiments of Dodge⁹³ and of Hall and Long, the fibre of *A. cannabinum* was shown to be of great strength and fineness, and of great promise, especially in the manufacture of paper.

Agriculturally, *Apocynum* offers great advantage over flax in the production of fibre. Unlike *Linum usitatissimum* and other commercial fibres of the flaxes, *A. cannabinum* thrives at its best upon arid land unfit for any other agricultural use. The studies of Fox, as well as those of Hall and Dodge, demonstrate that both the fibrous and the latex content of all species of *Apocynum* reaches its optimum upon such land. With square miles of such waste land lying idle in western North America, the value of such a crop should be enormous.

TAXONOMY

APOCYNUM [TOURN.] L.⁹⁴

Apocynum [Tourn.] L. Sp. Pl. ed. 1, 213. 1753; and ed. 2, 311. 1763; Gen. Pl. ed. 5, 101. 1754; Juss. Gen. 143. 1789; Sibth. Fl. Graeca 1: 166. 1806 (as to *Trachomitum*); Pursh,

⁹² Hall, H. M. & Long, F. L. Rubber-content of North American plants. Carn. Inst. Wash. Publ. 313: 65 pp. 3 pls. 1921.

⁹³ Dodge, C. R. Descriptive catalogue of useful fiber plants of the world. U. S. Dept. Agr. Fiber Investig. Rept. 9: 62-64. 1897.

⁹⁴ *Apocynum* L. char. emend. Calyx 5-partitus glaber vel pubescens eglandulosus. Corolla campanulata vel cylindrica, limbo 5-partito aestivatione sinistrorum contorta, squamellis 5 separatis in tubo corollae insertis. Stamina 5 tubo corollae affixa inclusa cum corollae sequentis alternatis, filamentis brevibus cylindricis,

Fl. Am. Sept. ed. 2, 1: 179. 1816; Nutt. Gen. 1: 161. 1818; Roem. & Schult. Syst. 4: 405. 1818; Michx. Fl. Bor.-Am. 1: 121. 1803; Hook. Fl. Bor.-Am. 1: 51. 1840; A. DC. in DC. Prodr. 8: 439. 1844; Benth. & Hook. Gen. Pl. 2: 716. 1876; Gray, Bot. Cal. 1: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; Gray, Syn. Fl. N. Am. 2¹: 82. 1886; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 179. 1895; Chapm. Fl. South. U. S. ed. 3, 341. 1897; Howell, Fl. N. W. Am. 1: 439. 1901; Britt. Man. Pl. 738. 1901; Rydb. Fl. Colo. 269. 1906; Robinson & Fernald in Gray, New Man. Bot. ed. 7, 662. 1908; Bég. & Bel. Rev. Monogr. Gen. Apocynum, in R. Accad. Lincei, Atti, Mem. Sci. Fis. V. 9: 1-144. 1913; Britt. & Brown, Ill. Fl. ed. 2, 3: 21. 1913; Small, Fl. Southeast. U. S. ed. 2, 936. 1913.; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Standl. Contr. U. S. Nat. Herb. 22¹: 395. 1921; Jepson, Man. Fl. Pl. Calif. 768. 1925; Tidestrom, Contr. U. S. Nat. Herb. 25: 419. 1925.

Apocynastrum Heistr. ex Fabric. Enum. Meth. Pl. 256. 1759.

Apocinum Juss. Gen. Pl. 146. 1789.

Cynopaema Lunell, Am. Mid. Nat. 4: 508. 1916.

Herbaceous lactescent perennials from somewhat thickened fibrous rhizomes. Stems erect or ascending, cylindrical, striate, glabrous or pubescent; branches ascending, alternate to opposite. Leaves opposite, petiolate or sessile, membranaceous, entire, penninerved, glabrous or pubescent, ovate to linear-lanceolate, bearing 2-6 small, attenuate, pectinate glands at the base of the petioles. Inflorescence a trichasial cyme, glabrous or pubescent, bracteate or ebracteate. Calyx regularly 5-lobed, glabrous or pubescent, the tube adnate to the receptacle, eglandular within. Corolla gamopetalous, campanulate to cylindrical, regularly 5-parted, glabrous, bearing within 5 distinct, sagittate appendages adnate to the base of the tube and opposite the lobes of the limb;

antheris sagittatis basi cum auriculis parallelis non verentibus instructis. Ovarium bilobum, lobis singularibus unilocularibus, ovulis in quoque loculo binis superpositis. Nectaria 5 integra supra discum propriam intra tubum calycis immersum. Folliculi teretes recti vel rarius falcati.—Herba perennis e rhizomate horizontali erecta ramosa, ramis ascendentibus plerisque alternis. Folia opposita petiolata vel sessilia et subamplexicaulia membranacea integra penninervia. Cymae pedunculatae terminales plus minusve compositae glabrae vel pubescentes.

limb erect, spreading or reflexed, sinistrorsely contorted in aestivation. Stamens 5, alternate with the appendages and attached to the base of the corolla-tube, convergent about the pistil; anthers of two small unilocular sporangia borne ventrally near the apex of an enlarged sagittate, peltately affixed connective; auricles of the anther connective parallel, with an open sinus, not convergent; filament short, cylindrical; pollen borne in persistent tetrads. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal stigma; ovules many, anatropous, borne upon an axile, binate placenta. Receptacle totally immersed in the calyx-tube, entire; nectaries 5, separate, ovate-cylindrical, situated upon the receptacle in a ring about the carpels. Follicles 2, divaricate, terete, containing many dry, apically comose, terete exaluminous seeds; embryo straight.

Type species: *Apocynum cannabinum* L. Sp. Pl. ed. 1, 213. 1753.

KEY TO THE SPECIES

- a. Leaves drooping or spreading (except 4-5); corolla at least twice the length of the calyx-lobes.
- b. Leaves drooping; corolla at least three times the length of the calyx-lobes (except 1b).
- c. Corolla campanulate, 5-10 mm. long, the orifice of the tube more than twice the width of the base; inflorescence rarely axillary as well as terminal; follicles normally pendulous; coma of the seeds 15-17 mm. long.
 - d. Lower surface of leaves glabrous.....1. *A. androsaemifolium*
 - dd. Lower surface of leaves tomentose. 1a. *A. androsaemifolium* var. *incanum*
 - cc. Corolla cylindrical, 4-6 mm. long, the orifice of the tube about equalling the width of the base; inflorescence usually axillary as well as terminal; follicles normally erect; coma of the seeds 12-15 mm. long.
 - d. Corolla about twice the length of the calyx-lobes; follicles unknown, but supposedly pendulous. 1b. *A. androsaemifolium* var. *intermedium*
 - dd. Corolla at least three times the length of the calyx-lobes; follicles frequent, erect, or nearly so.
 - e. Leaves glabrous.....2. *A. pumilum*
 - ee. Leaves variously pubescent.....2a. *A. pumilum* var. *rhomboideum*
- bb. Leaves spreading or ascending; corolla about twice the length of the calyx-lobes.
 - c. Leaves spreading; corolla relatively large, 4-5 mm. long.
 - d. Corolla campanulate, the tube scarcely longer than the spread of the limb; primarily eastern varieties.
 - e. Calyx and leaves variously tomentose; calyx-lobes lanceolate, acuminate, colored.

f. Corolla glabrous without; upper surface of leaves glabrous or glabrate..... 3. *A. medium*
 ff. Corolla hirsutous without; upper surface of leaves softly pubescent..... 3a. *A. medium* var. *sarniense*
 ee. Calyx and leaves glabrous; calyx-lobes oblong to ovate, abruptly acute, colorless..... 3b. *A. medium* var. *leuconeuron*
 dd. Corolla cylindrical, the tube conspicuously longer than the spread of the limb; western varieties.
 e. Plant completely glabrous..... 3c. *A. medium* var. *floribundum*
 f. Plant glabrous except the under surface of the leaves; calyx-lobes ciliate-erose..... 3d. *A. medium* var. *lividum*
 ff. Entire plant pubescent; calyx lobes entire..... 3e. *A. medium* var. *vestitum*
 cc. Leaves ascending; corolla 2-3 mm. long.
 d. Calyx-lobes ovate, about one-third the length of the corolla; corolla urceolate, about as long as broad..... 4. *A. Jonesii*
 dd. Calyx-lobes lanceolate, about one-half the length of the corolla; corolla cylindrical, about twice as long as broad.
 e. Leaves oblong, slightly spreading..... 5. *A. Suksdorffii*
 ee. Leaves narrowly lanceolate, strictly ascending..... 5a. *A. Suksdorffii* var. *angustifolium*
 aa. Leaves ascending, corolla barely exceeding the calyx.
 b. Leaves evidently petiolate, narrowed at the base, or the very lowest obtuse or sessile; bracts of the inflorescence scarious and aristate, not semifoliaceous or laminate; follicles relatively long and usually falcate, 12-20 cm. long, the coma of the seeds 20-30 mm. long.
 c. Calyx-lobes decidedly shorter than the corolla; corolla 2-3 mm. long.
 d. Plant pubescent, at least the lower surface of the leaves.
 e. Plant glabrous, except the lower surface of the leaves. 6. *A. cannabinum*
 ee. Inflorescence and both surface of the leaves pubescent..... 6a. *A. cannabinum* var. *pubescens*
 dd. Plant entirely glabrous..... 6b. *A. cannabinum* var. *glaberrimum*
 cc. Calyx-lobes equaling or slightly surpassing the corolla; corolla 3-4 mm. long..... 6c. *A. cannabinum* var. *Greeneanum*
 bb. Leaves nearly or quite sessile, especially the lowermost, cordate or obtuse at the base; bracts of the inflorescence semifoliaceous or laminate; follicles relatively short and straight, 4-10 cm. long, the coma of the seeds 8-20 mm. long.
 c. Corolla sphaerico-cylindrical, about as broad as long; coma of the seeds 8-12 mm. long; eastern and middle-western species.
 d. Leaves oblong to lanceolate, the bases obtuse to cordate.
 e. Plant glabrous..... 7. *A. hypericifolium*
 ee. Plant pubescent..... 7a. *A. hypericifolium* var. *Farwellii*
 dd. Leaves ovate to ovate-oblong, the bases deeply amplexicaul..... 7b. *A. hypericifolium* var. *cordigerum*
 cc. Corolla tubulo-cylindrical, longer than broad; coma of the seeds 15-20 mm. long; western species..... 7c. *A. hypericifolium* var. *salignum*
 1. *Apocynum androsaemifolium* L. Sp. Pl. ed. 2, 311. 1762;
 Walt. Fl. Carol. 107. 1788; Lam. Encycl. 1: 213. 1783; Michx.

Fl. Bor. Am. 1: 121. 1803; Pursh, Fl. Am. Sept. 1: 179. 1814; Ell. Sketch Bot. S. C. & Ga. 1: 314. 1821; Torr. Fl. N. & Mid. States, 275. 1824; Raf. Med. Bot. 1: 49. 1828; Darl. Fl. Cestr. 167. 1837; G. Don, Hist. Dichlam. Pl. 81. 1838; Strong, Am. Fl. 4: 72. 1850; Wood, Classb. Bot. ed. 29, 456. 1853; Darby, Bot. South. States, ed. 2, 434. 1860; Piper, Contr. U. S. Nat. Herb. 11: 453. 1906.

Apocynum fol. androsaemi L. Sp. Pl. ed. 1, 213. 1753.

Apocynum androsaemifolium L. var. *glabrum* Macoun, Cat. Can. Pl. 2: 317. 1884.

Apocynum ambigens Greene, Pl. Baker. 3: 17. 1901; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2: 193. 1911; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 669. 1917; Standl. Contr. U. S. Nat. Herb. 22: 395. 1921; Tidestrom, Contr. U. S. Nat. Herb. 25: 419. 1925; Garrett, Spring Fl. Wasatch Reg. 120. 1927.

Apocynum scopulorum Greene ex Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2: 193. 1911; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 505. 1915; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917.

Apocynum androsaemifolium L. var. *microphyllum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 87. 1913.

Apocynum ambigens Greene var. *bicolor* Bég. & Bel. l. c. 89. 1913, *non* MacGregor.

Apocynum androsaemifolium L. var. *typicum* Bég. & Bel. l. c. 80. 1913.

Apocynum occidentale Rydb. ex Bég. & Bel. l. c. 1913, *nomen in synon.*

Apocynum androsaemifolium L. var. *orbiculatum* (Greene) Bég. & Bel. l. c. 81. 1913.

Cynopaema androsaemifolium (L.) Lunell, Am. Mid. Nat. 4: 509. 1916.

Apocynum macranthum Rydb. Fl. Rocky Mts. ed. 2, 669. 1917.

Stems erect or ascending, 2-5 dm. tall, glabrous, freely and rather dichotomously branched, branches ascending, alternate to subalternate; leaves opposite, petiolate, drooping, ovate to oblong-lanceolate, membranaceous, glabrous, entire, mucronate, tapering at both base and apex; corolla campanulate, the base of the tube

less than one-half the breadth of the limb, 4-9 mm. long, the limb reflexed, 5-10 mm. broad at the orifice, calyx-lobes 1-3 mm. long, lanceolate to ovate-oblong, slightly flushed or colorless, glabrous; follicles 6-15 cm. long, pendulous, divergent, straight, not falcate, coma of seeds 1.5-2 cm. long, pale tawny-colored, seeds ovoid, 1 mm. long.

Distribution: woodlands, northwestern United States and adjacent Canada, eastward to the Dakotas, southward to California, Nevada, and Utah.

Specimens examined:

CANADA:

BRITISH COLUMBIA: bluff above Lardo, alt. 2000 ft., June 15, 1905, *Shaw* 680 (US, NY, MBG).

UNITED STATES:

SOUTH DAKOTA: Sylvan Lake, alt. 7000 ft., July 20, 1892, *Rydberg* 871 (NY); Black Hills, near Ft. Meade, July 27, 1887, *Farwood* 252 (US).

NEBRASKA: War Bonnet Canyon, alt. 5000 ft., June, 1890, *Williams* (US, MBG).

TEXAS: Davis Mts., Jeff Davis Co., upper Limpia Canyon, July 9-12, 1921, *Ferris & Duncan* 2542 (NY, US, MBG).

MONTANA: Bozeman, Sept. 5, 1901, *W. W. Jones* (G); Deer Lodge, 1901, *Scheuber* 1 (NY); Glacier Park, Aug. 18, 1919, *Standley* 17846 (NY, US); Nevada Creek, hillsides, July 11, 1883, *Canby* 226 (ANSP, US); Spanish Basin, Gallatin Co., June 23, 1897, *Rydberg & Bessey* 4701 (ND); Belton, Oct. 3-4, 1919, *Standley* 18821 (US); Grinnell Glacier, Glacier Nat. Park, July 31, 1919, *Standley* 16845 (US); Bigfork, alt. 3000 ft., Aug. 6, 1908, *M. E. Jones* 8881 (P); Darby, alt. 4000 ft., July 30, 1909, *M. E. Jones* (P); Yellowstone Park, Aug. 13, 1911, *Treakle* 159 (P); Rexford, Sept. 16, 1908, *M. E. Jones* 8880 (P).

WYOMING: open woods, Black Hills, July 25, 1910, *A. Nelson* 9491 (G); Whalen Canyon, July 19, 1894, *E. Nelson* 535 (US); Jaw-bone Gulch, July 9, 1896, *E. Nelson* 2027 (P); Sheridan Co., above Big Horn, June 26, 1897, *Pammel & Stanton* 71 (MBG); Jackson's Hole, Lincoln Co., alt. 6700 ft., dry roadside, Aug. 3, 1920, *Payson & Payson* 2186 (MBG).

COLORADO: Horsetooth Mt., July 20, 1897, *Crandall* 1013

(NY, US); Boulder Canyon, July, 1891, *Penard* 500 (NY); Morrison, June 19, 1881, *B. H. Smith* (ANSP); hills, Larimer Co., June 15, 1895, *Patterson* 6863 (P); Dome Rock in Platte Canyon, Aug. 8, 1878, *M. E. Jones* 572 (P); hillside near Odessa Lake, Larimer Co., elev. 10000 ft., Aug. 15, 1927, *Woodson* 1917 (MBG); dry slopes, Gregory Canyon, near Boulder, frequent, alt. 6000 ft., June 17, 1921, *H. C. Hanson* 276 (MBG); Steamboat Springs, Routt Co., shady hillsides, July 20, 1903, *Goodding* 1622 (MBG, NY, ANSP, US, F); Black Canyon, alt. 7000 ft., June 20, 1901, *Baker* 202 (MBG, US, NY, W); clearings in rocky coniferous forests, above Cub Lake, Larimer Co., July 5, 1929, *Woodson & Anderson* 29120 (MBG).

NEW MEXICO: data lacking, *Fendler* 690 (MBG, G); Wingfield's Ranch, Sacramento Mts., July 8, 1895, *Wooton* (US).

IDAHO: Challis Creek, Custer Co., base of rock slide in canyon, alt. 6000 ft., July 19, 1916, *Macbride & Payson* 3327 (G, P, MBG, US); Priest Lake, Aug., 1901, *Piper* 3786 (G, US); crevice in recent lava flow, Martin, Blaine Co., alt. 6000 ft., July 5, 1916, *Macbride & Payson* 3040 (G, NY, MBG); mountains, exact locality lacking, July, 1892, *Mulford* (G, MBG); Spencer, July 10, 1916, *Rust* 247 (US); Middle Fork of Weiser River, Washington Co., Aug. 3, 1899, *M. E. Jones* (P); Divide between Mullan and Canyon Creek, Coeur d'Alene Mts., alt. 1020 m., Aug. 7, 1895, *Leiberg* 1500 (MBG, G, US, NY, F); Priest River Exp. Sta., alt. 2700 ft., July, 1923, *Epling* 6088 (MBG); Trinity, Elmore Co., Aug. 8, 1910, *Macbride* 549 (MBG, US, W); Salmon, Lemhi Co., shaded roadside, alt. 4500 ft., July 3, 1920, *Payson & Payson* 1886 (MBG, NY); hills southeast of Victor, Teton Co., alt. 6500 ft., July 28, 1920, *Payson & Payson* 2170 (MBG, NY, G).

UTAH: City Creek Canyon, July 23, 1884, July 26, 1883, *Leonard* (G); Provo, moist semi-shaded places, June 16, 1902, *Goodding* 1127 (G, MBG, US, NY, ANSP, F, P); East Bountiful, Oct. 22, 1909, *Clemens* (NY); Parley's Canyon, Salt Lake Co., July 7, 1909, *Garrett* 2450 (MBG); Mt. Nebo, July 15, 1905, *Rydberg* 7761 (NY, US); Big Cottonwood Canyon, below Silver Lake, July 8, 1905, *Rydberg* 6772 (NY, US); Provo, July 2, 1894, *M. E. Jones* 5560 (P, US); Provo Slate Canyon, gravel, alt. 6000 ft., July, 1894, *M. E. Jones* 5613 (P, MBG); Ogden, June 28-Aug. 1, 1890, *Pammel* 5 (MBG).

NEVADA: Lee Canyon, Charleston Mts., alt. 8000 ft., July 25, 1913, *Heller* 10982 (MBG, US, G, NY); mountains west of Carson City, alt. 5000 ft., July 13, 1909, *Heller* 9815 (US).

WASHINGTON: Three Tree Point, common in open places, May 30, 1910, *Bardell & Frye* (MBG); Wenatchee, Aug. 6, 1896, *Whited* 142 (US); Loon Lake, July 20, 1897, *Wurston* (NY); Stehekin, Chelan Lake, July 6, 1911, *M. E. Jones* (P); Pullman, July, 1896, *Elmer* 6863 (P); Pullman, on north hillside-meadows, July 4, 1896, *Elmer* 138 (P); Pullman, July 25, 1900, *Piper* 3508 (US, W).

OREGON: Trail Creek Canyon, alt. 1600 ft., June 2, 1897, *Sheldon* 8208 (MBG, US); Emigrant Creek, Jackson Co., May 19, 1898, *Elmer* 2216 (US); Corvallis, common along roads, May, 1922, *Epling* 5574 (MBG).

CALIFORNIA: data lacking, *Bridges* 160 (NY); Strawberry, July, 1920, *Evans* (P).

There have been several misunderstandings concerning *A. androsaemifolium* which have had widespread circulation. One in particular concerns the pubescence or glabriety of the foliage. To practically all botanists who have had to do with the genus, the typical form of the species has been that of the collections from the eastern United States and Canada, the leaves of which have a densely tomentulose under surface. The western form with completely glabrous leaves has therefore frequently been relegated to some other designation, or ignored altogether. That the two forms are significant, however, their geographical distribution is proof. Linnaeus, in describing the species, spoke clearly of the foliage as "utrinque glabris," and A. deCandolle separated the glabrous typical form from a variety, var. *incanum*, a form with leaves "subtus pubescentibus." As a matter of fact, the possibility that Linnaeus's description was a careless description of the tomentulose form rather than a careful description of the glabrous form appears likely because of the abundance of the former. At any event, nomenclaturally, Linnaeus's *A. androsaemifolium* clearly describes the western glabrous variety, while deCandolle's var. *incanum* is as clearly the correct designation for the common dogbane of the eastern United States and Canada.

It is very rare to find the publication of *A. androsaemifolium*

L. correctly cited. Linnaeus first published the species (Sp. Pl. ed. 1, 213. 1753) as "*Apocynum fol. Androsaemi*." Notwithstanding, the original publication of *A. androsaemifolium* L. (Sp. Pl. ed. 2, 311. 1762) is almost invariably given in our floras as well as monographic work* as "Sp. Pl. ed. 1, 213. 1753," perhaps in an effort to save priority and therefore usage for the common appellation. Such an effort, however, is unnecessary, since Linnaeus's earlier name was never taken up as such, and was therefore long ago invalidated by the so-called "Fifty-year Rule" of the International Code of Nomenclature.

1a. *Apocynum androsaemifolium* L. var. *incanum* A. DC. in DC. Prodr. 8: 439. 1844; Wood, Classb. Bot. ed. 29, 456. 1853; Bég. & Bel. Atti R. Accad. Lincei V. 9: 84. 1913. Plate 9.

Apocynum muscipulm Moench, Meth. 464. 1794.

"*Apocynum androsaemifolium* L." acc. to Hooker, Fl. Bor.-Am. 1: 51. 1840; Torr. Fl. N. Y. 2: 116. 1843; A. Gray, Bot. Cal. 1: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; A. Gray, Syn. Fl. N. Am. 2¹: 82. 1886; Coulter, Contr. U. S. Nat. Herb. 2²: 262. 1892; MacMillan, Metaspermae Minn. Valley, 421. 1892; Coville, Contr. U. S. Nat. Herb. 4: 149. 1893; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 179. 1895; Chapm. Fl. South. U. S. ed. 3, 341. 1897; S. Coulter, Fl. Pl. Ind. 880. 1899; Rydb. Mem. N. Y. Bot. Gard. 1: 311. 1900; Mohr, Contr. U. S. Nat. Herb. 6: 674. 1901; Howell, Fl. N. W. Am. 1: 439. 1901; Piper, Contr. U. S. Nat. Herb. 11: 453. 1906; Rydb. Fl. Colo. 269. 1906; Robinson & Fernald in Gray, New Man. Bot. ed. 7, 662. 1908; Small, Fl. Southeast. U. S. ed. 2, 936. 1913; Britton & Brown, Ill. Fl. 3: 21. 1913; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Bergman, Fl. Rocky Mts. 668. 1917; Bergman, Fl. N. D. 229. 1918; Tidestrom, Contr. U. S. Nat. Herb. 25: 420. 1925; Garrett, Spring Fl. Wasatch Reg. 120. 1927.

Apocynum androsaemifolium L. f. *pauciflora* Peck, N. Y. State Mus. Rept. 47: 158. 1894.

Apocynum incanum (A. DC.) G. S. Miller, Proc. Biol. Soc. Wash. 13: 81. 1899, *in synon.*

Apocynum sylvaticum Greene, Leafl. Bot. Obs. & Crit. 2: 179. 1912.

* cf. Bég. & Bel. Monogr. *Apocynum*. Atti R. Accad. Lincei, V. 9: 79. 1913.

Apocynum androsaemifolium L. var. *puberulum* Bég. & Bel.
Atti R. Accad. Lincei V. 9: 81. 1913.

Lower surface of leaves distinctly tomentulose or pubescent, in all other essential characters similar to the species.

Distribution: woodlands, occasionally in waste-lands, all over temperate North America, with a probable center of distribution in the northeastern United States and adjacent Canada.

Specimens examined:

NEWFOUNDLAND: open woods near the confluence of the Exploits River and Badger Brook, Aug. 12, 1894, *Robinson & Schrenk* 96 (G, MBG, US, F); ledges and talus, north bank of Exploits River below the falls, Grand Falls, July 22, 1911, *Fernald & Wiegand* 6087 (G); Bishop Falls, July 28, 1911, *Fernald & Wiegand* 6088 (G); "Sunnyside," Bay of Islands, fields, date lacking, *Waghorne* (MBG).

CANADA:

NOVA SCOTIA: dry open soil, Middleton, July 21, 1920, *Bissell, Pease & Long* 22315 (G); dry exposed serpentine ledges in thin upland woods, Middlefield, June 26, 1913, *Fernald & Long* 10240 (G); near "Sunny Brae," Pomquet, July 11, 1927, *Woodson 1713* (MBG); sandy thicket, Kentville, Aug. 22, 1902, *Fernald* (G); fields near Tarbet Vale, Cape Breton Island, July 23, 1914, *Nichols* 289 (G); Ridge Road, above Springfield, Aug. 6, 1910, *Greene* (US, ND); edge of fields, near Windsor, July 21, 1857, *Howe* (NS).

PRINCE EDWARD ISLAND: dry clearing, Alberton, July 11, 1912, *Fernald & St. John* 7950 (G).

NEW BRUNSWICK: Shediac, roadside, July 30, 1925, *Knowlton* (G); rich shaded soil, Shediac Cape, July 23, 1914, *Hubbard* (G); near Moncton, July 13, 1927, *Woodson* 1714 (MBG); near McKinnon, July 13, 1927, *Woodson* 1651 (MBG).

QUEBEC: gravelly beaches and flats, between Baldé and the Baie des Chaleurs, Bonaventure River, Aug. 5-6-8, 1904, *Collins, Fernald & Pease* 5877 (G); Rivière Vaureal: le long du rivage de la rivière, July 28, 1925, *Victorin & Germain* 21988 (G); near Ouatchouan Falls, Lake St. John, Aug. 29, 1904, *Wright* 229 (G, US); mossy woods along the trail between Mont St. Louis and Lac Mont Louis, July 30, 1923, *Fernald, Dodge & Smith* 25988

(G); vicinity of Longueuil, Sept. 19, 1919, *Victorin* 9652 (G); Lac Tremblant, Terrebonne Co., Aug. 4, 1922, *Churchill* (MBG, G, NY, US).

ONTARIO: Fort William, July 31, 1912, *Williamson* 1692 (ANSP); Lake Cache, June 26, 1900, *Macoun* (US); cemetery near London, *Saunders, Anderson & Woodson* (MBG); vicinity of Ottawa, July 11, 1906, *Rydberg* (NY); St. Thomas, June 25, 1906, *Fisher* (D); near Heyden, 75 mi. north of Mackinac Straits, Aug. 2, 1906, *E. B. Williamson* (B); island in Lake Timagami, July, 1929, *Gilmour* (MBG).

MANITOBA: Lake Winnipeg Valley, 1857, *Bourgeau* (G, US); Brandon, July 20, 1896, *Macoun* (US); Athabasca, Aug. 12, 1901, *Preble & Preble* 175 (US).

SASKATCHEWAN: exact locality not cited, 1857-58, *Bourgeau* (G).

BRITISH COLUMBIA: Goldstream, alt. 2200 ft., Aug. 3, 1905, *Shaw* 1064 (G, MBG, US, NY, F); hillside, Carbonate, alt. 2750 ft., July 9, 1904, *Snyder* 217 (G, US); Bald Mt., Cowichan Lake, June 17, 1907, *Rosendahl* 1835 (NY, G, MBG); Telegraph Creek, Cassiar district, July 20, 1910, *Preble & Mixter* 549 (US); Glacier, Illecillewaet Valley, Loop Trail, alt. 3500-4000 ft., July 20, 1906, *Brown* 655 (G); lower Frazer River, 1859, *Lyall* (G); open ground, Victoria, date lacking, *J. R. Anderson* (W); orchards, Crawford Bay, date lacking, *Harrison* (W); river-bank, Skeena River, Comox District, Sept. 10, 1910, *J. R. Anderson* 500 (W).

UNITED STATES:

MAINE: gravelly thicket, Sangerville, June 29, 1895, *Fernald* 245 (G, MBG, US, NY); gravelly river-beaches, Fort Fairfield, July 16, 1902, *Williams, Collins & Fernald* (NE); Caribou, July 18, 1902, *Williams* 1 (G); open woods, Green Mt., Mt. Desert, July 18, 1899, *Williams* (G); Augusta, July 10, 1886, *E. C. Smith* (MBG); Roque Bluff, dry sandy fields and roadsides, Aug. 11, 1907, *Cushman & Sanford* 1621 (NE); Seal Harbor, Wildwood Farm, Sept. 1, 1892, *Rand* (NE); Standish, sandy clearings, Aug. 28, 1916, *Fernald & Long* 14398 (NE, ANSP); Winthrop, 1864, *Sturtevant* (MBG); Topsham, bank of Androscoggin River, Aug. 26, 1912, *Furbish* (NE); Bridgton, July 9, 1912, *Martin* (NE); Swans Island, clearing on Stockbridge Hill, July, 1914, *Hill* 1540 (NE).

NEW HAMPSHIRE: Glen, White Mts., Sept. 17, 1892, *Kennedy* (G); Jaffrey, July 23, 1896, *Day* 70 (G, US); Randolph, along roadsides, July 27, 1897, *Williams* (G); Conway Center, Aug. 4, 1875, *Lane* (G); Gorham, R. R. tracks, Sept. 6, 1918, *Pease* 17845 (NE); Gilman, summit of Shannon Mt., exposed granite, July 22, 1907, *Cushman & Sanford* 1296 (NE); Merrimack, open roadside bordering swamp, Aug. 11, 1917, *Batchelder* (NE).

VERMONT: Derbyline, dry knoll, July 19, 1914, *Churchill* (NE); Pownal, roadside, Aug. 2, 1898, *Churchill* (G); Arlington, July 3-4, 1903, *Eggleston* 3291 (G, US); Manchester, roadside, July 14, 1898, *Day* 19 (G, US); Mt. Mansfield, June 25, 1900, *Howell* (US); Peacham, July 12, 1885, *Blanchard* (MBG); Caledonia Co., July 2, 1884, *Blanchard* (MBG); Fairlee Center, Sept. 3, 1927, *E. Anderson* 2700 (MBG); Vergennes, July 9, 1908, *Kennedy* (NE); East Wallingford, meadow, July 1, 1897, *Kent* (NE).

MASSACHUSETTS: West Tisbury, along road, Sept. 5, 1917, *Seymour* 1431 (G); Conway, July 12, 1907, *Williams* (G); Waltham, open, slightly sandy roadside, Aug. 14, 1912, *Robinson* 741 (G); West Roxbury, date lacking, *Faxon* (G); Tewksbury, June 27, 1853, *Boott* (G); Ipswich, borders of thickets, July 21, Sept. 10, 1874, *Morong* (MBG); Granville, Sept. 19, 1913, *Seymour* 53 (MBG, G); Holbrook, June 18, 1899, *Greenman* 616 (MBG); river-bank, Shelburne Falls, Franklin Co., July 1, 1921, *Churchill* (MBG, NY, US); Oak Island, July 9, 1898, *Greenman* 3106 (MBG); Nonquit, 1888, *Sturtevant* (MBG); Alford, Aug., 1898, *Milligan* (MBG); South Framingham, July 3, 1890, *Sturtevant* (MBG); Pride's Crossing, dry loamy gravel, July 11, 1913, *Hubbard* (NE); Framingham, dry woods, July 13, 1911, *Eames* (NE); Lexington, moist pastures, Aug. 4, 1906, *Knowlton* (NE).

RHODE ISLAND: North Smithfield, damp ditch on roadside, Aug. 4, 1910, *Hope* 453 (NE); Foster, July 7, 1913, *Torrey* 748 (NE); Cumberland, roadside, May 30, 1911, *Ware* (NE); Tiverton, roadside, July 7, 1909, *Sanford* (NE); Middletown, July 17, 1898, *Simmons* (NE).

CONNECTICUT: Hartford, July 16, 1900, *Driggs* (NE); Trumbull, June 22, 1892, *E. H. Eames* (NE); Southington, woods and roadsides, common, June 14-Aug. 20, 1899, *Bissell* (NE); Water-

bury, July 27, 1912, *Blewitt* 3674 (G); East Greenwich, 1861, *Fitch* (US).

NEW YORK: Sylvan Beach, Oneida Co., July 11, 1905, *House 1208* (G, NY); Lisbon, dry roadsides, July 9, 1914, *Phelps* (G); South Bay, Wellesley Is., June 28-30, 1902, *T. R. Robinson & W. R. Maxon 37* (G); Cape Vincent, July, 1905, *Keller* (ANSP); Fleischmann's, Delaware Co., July 13, 1892, *Schrenk* (MBG); Granville Tp., Washington Co., Aug. 19, 1921, *Drushel 2434* (MBG); Little Moose Lake, Herkimer Co., July 5, 1906, *Van Pelt* (ANSP); Goat Island, Niagara River, July 19, 1870, *Boice* (ANSP); near Oneida, July 8, 1909, *Mrs. Maxon 4541* (ANSP); Ithaca, Cascadilla Creek, June 18, 1877, *Trelease* (MBG); New London, June 28, 1921, *House 8294* (NY); Ithaca, dry woods, June 28, 1916, *Munz 599* (P); Norwich, Chenango Co., June 24, 1887, *Fitch* (P).

NEW JERSEY: Windham road, July, 1889, *R. C. Perry* (MBG); Netcong, Morris Co., Aug. 19, 1906, *Mackenzie 2290* (MBG, NY, US); Lakewood, Ocean Co., sandy woods, May 30, 1908, *Mackenzie 3102* (MBG, NY).

PENNSYLVANIA: Bushkill, Pike Co., June 30, 1917, *Bartram* (G, ANSP); Binton, Columbia Co., July 8, 1921, *Meredith* (ANSP); Tannersville, July 4, 1901, *S. Brown* (ANSP); Meadville, June 30, 1893, *C. D. Curtis* (P); Columbia, June, 1889, *Eby* (MBG); moist places along the Susquehanna trail near Selinsgrove, Aug. 4, 1926, *Heller 14232* (MBG, US); bluff along the Susquehanna River above Nescopeck, about or near trees, Aug. 3, 1926, *Heller 14204* (MBG); Northampton Co., 1880, *Rau 66* (MBG); Mt. Alto, 1909, *Ilick* (MBG).

DELAWARE: Centerville, July, 1865, *Commons* (MBG, ANSP).

MARYLAND: Oakland, Garrett Co., July 7, 1881, *Donnell-Smith* (US, G); Oakland, July 12, 1899, *Greene* (US).

VIRGINIA: Stony Man Mt. and vicinity, near Luray, alt. 3700 ft., Aug. 15, 1901, *Steele & Steele 238* (MBG, US, NY); Shannon Gap, Walker Mt., Smyth Co., June 21, 1892, *Britton, Britton & Vail* (NY); Peaks of Otter, Bedford Co., July 26-Sept. 1, 1871, *Curtiss* (G, US).

WEST VIRGINIA: Bucklin, Upshur Co., June 10, 1895, *Pollock* (MBG, US).

NORTH CAROLINA: open woods and fields, Biltmore, Buncombe Co., July 16, 1897, *Biltmore* 80b (MBG, P, G, US, NY); "mountains of North Carolina," exact locality and date lacking, *Ashe* (US).

OHIO: Put-in-Bay, July 10, 1920, *Moseley* (G); Rocky River, near Cleveland, July 13, 1896, *Greenman* 1437 (G, MBG); Columbus, date lacking, *Sullivant* (G); Painesville, June, 1885, *Beardslee* (US).

MICHIGAN: Stevensville, sandy ground near railroad, July 3, 1911, *Lansing* 3213 (G, F); Burt Lake, roadside, July 27, 1917, *Ehlers* 559 (G, US); Hamlin Lake, Ludington, July 25, 1910, *Chaney* 92 (G); Turin, Marquette Co., July 8, 1901, *Barlow* (G); Iron Mt., June, 1885, *Rydberg* 130 (NY); Schoolcraft, railroad banks, June 6, 1903, *Burgess* 62 (F); roadside banks 15 miles west of Ann Arbor, Aug. 22, 1926, *Heller* 14258 (MBG); Lansing, July 7, 1867, *Sleeper* (MBG); Gt. Manitou Is., Lake Superior, July 26, 1886, *Wislizenus* 579 (MBG); Houghton Co., Aug., 1892, *Eby* (MBG); Ypsilanti, June 23, 1892, *Farwell* (US).

INDIANA: Gibson, sandy ridges, Aug. 10, 1910, *Lansing* 2820 (G, US, F); Millers, dry copse, July 7, 1908, *Lansing* 2764 (G, F); Whiting, Aug. 29, 1893, *Britton* (NY); Notre Dame, Aug. 5, 1909, *Nieuwland* (MBG); Bluffton, along fence $\frac{1}{2}$ mile east of town, June 24, 1906, *Deam* 1125 (MBG, D); Michigan City, July 3, 1903, *Mell* 23 (MBG, US); Gary, July 19, 1907, *Greenman* 1864 (MBG); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland*, *Slavin & Woodson* 2 (MBG); bank of the St. Mary's River about 2 mi. southeast of Pleasant Mills, Adams Co., June 25, 1925, *Deam* 41342 (D); Fulton Co., along the Lake Erie Railroad, between Rochester and Tiosa, not frequent, June 25, 1911, *Deam* 8923 (D); high bank of the Salamanie River, 1 mi. east of Montpelier, Blackford Co., June 22, 1925, *Deam* 41320 (D); dry wooded bank of Cedar Creek, about 3 mi. above Cedarville, Allen Co., June 14, 1914, *Deam* 14283 (D); black oak sand hill along roadside, 5 mi. west of Gifford, Jasper Co., July 14, 1920, *Deam* 31710 (D); Marshall Co., on the border of Lake Maxinkuckee, just south of Culver, July 2, 1911, *Deam* 8997 (D); on wooded dune about 2 mi. west of Michigan City, not frequent, June 18, 1911, *Deam* 8848 (D).

WISCONSIN: Brown Co., 1886, Scheutte (G); River Falls, Aug., 1903, Powell (G); Waupaca, 1907, Garesche (MBG); woods near Mirror Lake, Sauk Co., Aug. 23, 1903, Eggert (MBG); low open ground, near lake, Odanah, Ashland Co., Sept. 11, 1925, E. J. Palmer 28651 (MBG); Burg road, near Garrett Bay Inn, Ellison Bay, Door Co., July 16, 1918, M. T. Greenman 52 (MBG); St. Croix Falls, Polk Co., July 10, 1899, C. F. Baker (P); Arena, date lacking, Carr (P).

ILLINOIS: Urbana, date lacking, Gleason (G); Flossmoor, Aug. 1, 1909, Greenman 2815 (G, MBG, NY); Decatur, 2 miles from Moffit's Bridge, on the Moffit road, June 29, 1895, Gleason 336 (G); bank of Desplaines river, Maywood, June 24, 1898, A. Chase (MBG, US); steep clay bank near Wady Petra, June 30, 1900, V. H. Chase 647 (MBG, US); Illinois State Park, Starved Rock, LaSalle Co., June-Sept. 1921, Thone 61 (MBG, F); Cook Co., July, 1870, Babcock (MBG, US); Lake Forest, May-Sept., 1897, Jensen (MBG).

MINNESOTA: Clithrall, July, 1897, Campbell (G); Bemidji, Beltrami Co., June, 1902, Brand 591 (F); Taylor's Falls, July 28, 1900, Banks 21 (ND, US); Norway Beach, Cass Lake, sandy soil, border of woods, July 9, 1925, Pammel 864 (MBG); Itaska Lake, June 29, 1892, Sandberg (US); Soudan, St. Louis Co., July, 1896, Eby (MBG); Center City, July, 1892, Taylor (W), borders of thickets, Fish Lake, Mahnomen Co., July 21, 1908, Chandonnet (D).

IOWA: Iowa City, 1889, Hitchcock (MBG); Ames, Aug. 26, 1897, Johnson (MBG); border of woods, Fayette Co., July, 1894, Fink (US).

MISSOURI: Ironton, June 23, 1897, Savage & Steele 310 (F); Joplin, rocky ground, June 7, 1909, E. J. Palmer, 2129 (G, MBG, US); Dumas, rocky banks, July 6, 1909, Bush 5871 (MBG, G, US); Eagle Rock, uncommon, near spring, June 26, 1897, Bush 15 (G, MBG, US); near Allenton, high sandy hill, June 30, 1912, Letterman (MBG); Howell Co., Aug. 12, 1892, Bush (MBG); rocky hills, St. Louis Co., May 15, 1896, Eggert (MBG); "rare and local, a clump at Castle Rock," Turkey Creek, near Joplin, June 7, 1909, E. J. Palmer 2172 (MBG, US); Jerome, June 16, 1914, Kellogg (MBG); open rocky woods, north slope along

Turkey Creek, near Joplin, Jasper County, June 22, 1928, *E. J. Palmer* 34643 (MBG); thickets along rocky creek near Mansfield, Wright Co., June 25, 1928, *E. J. Palmer* 34692 (MBG).

ARKANSAS: rocky open ground, near top of Magazine Mt., Logan Co., June 11, 1923, *E. J. Palmer* 23248 (MBG).

NORTH DAKOTA: Minot, July 2, 1907, *Lunell* (NY); Devil's Lake, Ramsey Co., July 1, 1905, *Lunell* (NY, US, ND, D); Turtle Mts., Bottineau Co., July 21, 1905, *Lunell* (ND, D); roadsides, open plain, Turtle Mts., July 29, 1910, *Lunell* (US); Des Lacs, Ward Co., August 22, 1908, *Lunell* (D).

SOUTH DAKOTA: damp woods, Warren's Woods, June 14, 1902, *Johnson* (MBG); Rockerville, Black Hills, June 15-30, 1909, *White* (MBG); Simpson Park, June, 1895, *Griffiths* (MBG); Deadwood, hillsides, July 13, 1913, *Rydberg* 95 (MBG, NY); Deadwood, hillsides, July 13, 1913, *Carr* 95 (G); Rapid City, alt. 3700 ft., June 25, 1892, *Rydberg* 871 (G); Redfern, elev. 5700 ft., July 12, 1910, *Murdock* 4214 (G).

NEBRASKA: Belmont, July 24, 1889, *Webber* (MBG).

MONTANA: Red Lodge, July 24, 1893, *Rose* 2 (G, US); Mt. Bridger, Gallatin Valley, alt. 5,000 ft., Aug. 10, 1905, *M. E. Jones* (P); McDougall Peak, Schultze's Cabin, alt. 3500 ft., July 29, 1908, *M. E. Jones* (P); Butte, June, 1892, *Keller* (ANSP); Bozeman, dry mountain slopes, frequent, July 28, 1901, *Blankinship* (MBG, US); Bigfork, July-Aug. 1907, *Elrod* (MBG).

WYOMING: Nez Perces Creek, July 29, 1899, *Nelson & Nelson* 6206 (G); Leigh's Lake, open woods, July 24, 1901, *Merrill & Wilcox* 1084 (G, US); Chug Creek, Albany Co., rocky slopes among the hills, June 29, 1900, *A. Nelson* 7329 (US, MBG); Black Hills, open woods, July 25, 1910, *A. Nelson* 9491 (MBG, US, NY).

COLORADO: Manitou, Oct. 9, 1905, *Glatfelter* (MBG); base of Palisade Mt., Larimer Co., elev. 8000 ft., Aug. 12, 1927, *Woodson* 1822 (MBG); Roger's, Aug. 14, 1901, *Baker* 799 (MBG, US, NY, G, ND, F, ANSP, P); Boulder, 1908, *Pace* 472 (MBG); Artist's Glen, alt. 2800 m., July 22, 1900, *Clements & Clements* 107 (G, US, MBG, NY, F); Tabergauche Basin, exposed sandy hillside, alt. 8500 ft., Aug. 18, 1913, *Payson* 178 (MBG, G, US); Steamboat Springs, shady hillsides, July 20, 1903, *Gooodding* 1622 (G),

US); Engelmann Canyon, 2700 m., July 27, 1901, *Clements & Clements* 398 (MBG, G, US); Pagosa Springs, July 17, 1899, *Baker* 527 (MBG, US, ND, P, G); Mancos, July 9, 1898, *Baker, Earle & Tracy* 840 (P, G); Canyon City, 1872, *Brandegee* (MBG); San Juan Mt., near Pagosa Springs, Aug. 14, 1917, *Payson* 1172 (MBG); Green Lake, alt. 10000 ft., July 5, 1886, *Letterman* (MBG); Upper Clear Creek Valley, Aug. 6, 1874, *Engelmann* (MBG); Piedra, July, 1899, *Baker* 527 (F); Twin Lakes, 1873, *Rothrock & Wolf* 45 (ANSP); Wahatoya Creek, July 7, 1900, *Rydberg & Vreeland* 5756 (NY); rocky shores of Arkansas River, near Granite, Chaffee Co., July 3, 1929, *Woodson & Anderson* 29089 (MBG); rocky hillsides below Independence Pass, Lake Co., alt. 9500 ft., July 3, 1929, *Woodson & Anderson* 29123 (MBG); stream banks, near mouth of North St. Vrain Canyon, west of Lyons, Boulder Co., July 9, 1929, *Woodson & Anderson* 29002 (MBG).

NEW MEXICO: Pecos River National Forest, Winsar's Ranch, alt. 8400 ft., July 1, 1908, *Standley* 4102 (MBG, US); Pews River, July 23, 1898, *Coghill* 96 (MBG); Colfax Co., alt. 7500 ft., June, 1896, *St. John* 42 (G); Lookout Mines, Sierra Co., June 14, 1904, *Metcalfe* 981 (G, US, P); locality lacking, 1847, *Fendler* (G, MBG); Cloudcroft, June 30, 1899, *Wooton* (P, US); vicinity of Chama, Rio Arriba Co., July 10, 1911, *Standley* 6791 (US); Eagle Creek, Lincoln Co., July 14, 1895, *Wooton* (NY); dry open hillside, northwest of Chama, Rio Arriba Co., June 26, 1929, *Woodson & Anderson* 29112 (MBG).

IDAHO: Upper Priest River, July 8, 1925, *Epling* 7182 (F); Oxford, July 21, 1883, *Coville* (US); "mountains," exact locality lacking, July, 1892, *Mulford* (MBG).

UTAH: Red Butte Canyon, vicinity of Salt Lake City, July 11, 1908, *Clemens* (MBG); Alta, Wasatch Mts., alt. 8000 ft., Aug. 14, 1879, *M. E. Jones* 1272 (P); Salt Lake City, July 19, 1904, *Scheuber* (US).

ARIZONA: Miller's Canyon, Huachuca Mts., dry burnt slopes, June 8, 1909, *Goodding* 120 (G, US); Pine Canyon, Chiricahua Mts., alt. 7200 ft., June 26, 1907, *Blumer* 1543 (G, MBG, US); Baker's Butte, July 28, 1897, *Mearns* (NY); Flagstaff, July 8, 1898, *MacDougal* 254 (ANSP); near Soldier's Camp, Santa

Catalina Mts., July 30, 1916, *Harris* 16394 (MBG); Santa Catalina Mts., Pima Co., June, 1891, *Rhoads* (ANSP).

WASHINGTON: Clark Springs, Spokane, July 7, 1902, *Kreager* 89 (G); Mt. Constitution, San Juan Islands, June 25-Aug. 1, 1917, *Zeller & Zeller* 1187 (G, MBG); Lake Chelan, July 1, 1915, *Kammerer* (NY); Moulisano, Aug. 14, 1917, *Grant* (NY); Falcon Valley, July, 1908, *Suksdorf* (NY).

OREGON: Portland, 1868, *Kellogg & Harford* 842 (NY); Columbia River Valley, Aug., 1884, *Ball* (MBG).

CALIFORNIA: Sierra Co., 1874, *Lemmon* (G); Dollar Lake Canyon, San Bernardino Co., alt. 9000-9500 ft., July 12, 1908, *Abrams & MacGregor* 774 (G); dry gravel bank, east fork of Lost Creek, San Bernardino Co., alt. 8500 ft., July 15, 1924, *Munz & Johnston* 8596 (G, P); near Dry Lake, along stream, alt. 8000 ft., July 16, year lacking, *Crawford* (P); Bluff Lake, San Bernardino Co., alt. 7500 ft., June 15, 1905, *Grinnell* 78 (P); North Bay, Bear Valley, dry shore, Aug. 1, 1922, *Pierce* (P); Bear Valley, San Bernardino Mts., alt. 6600 ft., July 19, 1900, *M. E. Jones* (P).

MEXICO: San Pedro Martir Mts., exact locality lacking, July 15, 1905, *Goldman* 1221 (US); Colonia Garcia, Chihuahua, in Sierra Madres, June 12, 1899, *Townsend & Barber* 33 (US, MBG, P).

1b. *Apocynum androsaemifolium* L. var. *intermedium* Woodson, n. var.^{**}

Corolla cylindrical, about twice the length of the calyx-lobes; in all other essential characters similar to the species.

Distribution: known only from the type locality in north-central Colorado (for a detailed account of this variety see pp. 72-73).

Specimens examined:

COLORADO: evidently *A. androsaemifolium* var. *incanum* × *A. medium* var. *floribundum*. Growing with those species below Eagle Cliffs, Moraine Park, Larimer Co., July 25, 1929, *Woodson & Barnhart* 29032 (MBG).

^{**} *Apocynum androsaemifolium* L. var. *intermedium*, var. nov., herbaceum perenne, varietatem genuinam simulans differt foliis subtus pilosis corollae tubo cylindrico calycis lobis dimidio majoribus.

2. *Apocynum pumilum* (A. Gray) Greene, Man. Bot. San Francisco Bay, 240. 1894; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 91. 1913; Piper & Beattie, Fl. S. E. Wash. 194. 1914; Rydb. Fl. Rocky Mts. ed. 2, 669. 1917; Standl. Contr. U. S. Nat. Herb. 22: 395. 1921.

Apocynum androsaemifolium L. var. *pumilum* A. Gray, Syn. Fl. N. Am. 2¹: 82. 1886; Howell, Fl. N. W. Am. 1: 439. 1901; Piper, Contr. U. S. Nat. Herb. 11: 453. 1906; Frye & Rigg, Northwest. Fl. 308. 1912; Smiley, Bor. Fl. Sierra Nev. Cal. 300. 1921; Jepson, Man. Fl. Pl. Cal. 769. 1925.

Apocynum calophyllum Greene, Leafl. Bot. Obs. & Crit. 1: 57. 1904; Tidestrom, Contr. U. S. Nat. Herb. 25: 420. 1925.

Apocynum cardiophyllum Greene, l. c. 79. 1904.

Apocynum bicolor McGregor, Bull. Torr. Bot. Club 37: 261. 1910.

Apocynum ovalifolium Greene, l. c. 2: 182. 1912.

Apocynum paniculatum Greene, l. c. 183. 1912.

Apocynum stenolobum Greene, l. c. 1912.

Apocynum eximium Greene, l. c. 1912.

Apocynum plumbeum Greene, l. c. 185. 1912; Tidestrom, Contr. U. S. Nat. Herb. 25: 420. 1925.

Apocynum xylosteaceum Greene, l. c. 1912.

Apocynum rotundifolium Greene, l. c. 186. 1912.

Apocynum Austinae Greene, l. c. 188. 1912.

Apocynum cercidium Greene, l. c. 1912.

Apocynum luridum Greene, l. c. 189. 1912.

Apocynum pumilum (A. Gray) Greene var. *typicum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 91. 1913.

Apocynum hypericifolium Ait. var. *intermedium* Bég. & Bel. l. c. 92. 1913, *nomen in synon.*

Apocynum pumilum (A. Gray) Greene var. *cercidium* (Greene) Bég. & Bel. l. c. 94. 1913.

Apocynum pumilum (A. Gray) Greene var. *calophyllum* (Greene) Bég. & Bel. l. c. 1913.

Apocynum pumilum (A. Gray) Greene var. *ovalifolium* (Greene) Bég. & Bel. l. c. 1913.

Apocynum pumilum (A. Gray) Greene var. *xylost[e]aceum* (Greene) Bég. & Bel. l. c. 95. 1913, *err. typ.*

Apocynum pumilum (A. Gray) Greene var. *plumbeum* (Greene)
Bég. & Bel. l. c. 95. 1913.

Apocynum pumilum (A. Gray) Greene var. *stenolobum* (Greene)
Bég. & Bel. l. c. 96. 1913.

Apocynum androsaemifolium L. var. *nevadense* Jepson, Man.
Fl. Pl. Cal. 769. 1925.

Stems erect, ascending, or diffuse, 1-4 dm. tall, freely and rather dichotomously branched, branches ascending or spreading, alternate to subalternate, glabrous; leaves opposite, ovate to oblong-lanceolate, petiolate to subsessile, drooping, acute to obtuse at base and apex, or cordate-ovate, membranaceous, entire, mucronate, or without mucro, glabrous; corolla cylindrical, 4-6 mm. long, 4-5 mm. broad at the orifice, the base of the tube more than one-half the breadth of the limb, the limb erect or slightly spreading, rarely reflexed except in withering; calyx-lobes lanceolate to oblong-ovate, 1-1.5 mm. long, colorless to deeply tinted, glabrous; follicles 5-12 cm. long, erect, divergent, straight, not falcate, coma of seeds 1-2 cm. long, clear white, or occasionally tawny-colored, seed ovoid-cylindrical, 1.5-2 mm. long.

Distribution: western temperate North America; frequent in the Pacific coast area, less frequent inland to the Rocky Mountains.

Specimens examined:

MONTANA: Big Fork, July 21, 1908, *Butler* 2181 (NY); Blackfoot Valley, north bank of irrigating ditch, July 23, 1921, *Kirkwood* 1253 (MBG); slopes of Altyn Peak, Glacier Nat. Park, alt. 1480-1720 m., July 13, 1919, *Standley* 15553 (G, US); Deep Creek Co., July, 1883, *Scribner* 152 (G); Spring Gulch, Hellgate Canyon, July 13, 1921, *Kirkwood* 1252 (MBG).

WYOMING: Encampment, Carbon Co., river bottoms, July 10, 1901, *Tweedy* 4640 (NY, US); Alpine, Lincoln Co., on the Snake River near the Idaho boundary, open slopes, July 7, 1923, *Payson* & *Armstrong* 3382 (P, MBG); Nez Perces Creek, on dry slopes and flats, July 29, 1899, *Nelson* & *Nelson* 6206 (MBG); Dale Creek, Aug. 24, 1908, *Clemens* (MBG).

IDAHO: Martin, Blaine Co., July 5, 1916, crevice in recent lava flow, alt. 6000 ft., *Macbride* & *Payson* 3040 (MBG); valley of

Big Potlach River, Nez Perces Co., July 9, 1892, *Sandberg*, *MacDougal & Heller* 372 (G); Salmon, Lemhi Co., alt. 4500 ft., July 3, 1920, *Payson & Payson* 1886 (MBG, G); Boise, alt. 2880 ft., mountain sides everywhere, Sept. 14, 1911, *Clark* 330 (G); Tamarack, Washington Co., Aug. 12, 1911, *Clark* 243 (MBG); Boise, Clear Creek, open hillsides, alt. 5000 ft., July 4, 1911, *Clark* 101 (MBG, W); Mann's Creek, Washington Co., alt. 2200 ft., July 8, 1899, *M. E. Jones* 6447 (MBG, P); Moscow, Latah Lake, June, 1900, *Abrams* 701 (P); region of Coeur d'Alene Mts., alt. 640 m., Aug. 17, 1895, *Leiberg* 1546 (P); Moscow Mts., along road, June 28, 1925, *Eastwood* 13363 (P); Selway Forest, between Elk Summit and Kooskooska Meadows, alt. 7000 ft., Aug. 15, 1923, *Kirkwood* 1594 (Epling Herb.); Revett Lake, alt. 5000-6000 ft., Aug. 10, 1926, *Epling, Houck & Putnam* 10119 (Epling Herb.); Moyie Springs, Aug. 30, 1926, *Epling* 10426 (Epling Herb.); Beaver Creek, Bonner Co., June 29, 1925, *Witham* 8990 (Epling Herb.); Bonner Co., common, open brush land, May 24, 1925, *Witham* (Epling Herb.); Priest Lake, Aug., 1901, *Piper* 3786 (Epling Herb.); Thatuna Hills, July 4, 1926, *Epling & Houck* (Epling Herb.).

UTAH: Wasatch Mts., July, 1869, alt. 6500 ft., *Watson* 957 (G); Wasatch Mts., 1877, *Hooker & Gray* (G); Salt Lake City, 1872, *Engelmann* (MBG); East Bountiful, Sept. 22, 1909, *Clemens* (P); City Creek Canyon, Sept. 11, 1880, *M. E. Jones* (P); same locality, June 29, 1880, *M. E. Jones* (P).

NEVADA: King's Canyon, Ormsby Co., alt. 1700-2000 m., June 21, 1902, *Baker* 1122 (US, MBG, G, P, NY, F); on mountain slopes west of Carson City, elev. 1800 m., July 5, 1919, *Tidestrom* 10255 (NY, US, G); Little Valley, Washoe Co., alt. 2000-2500 m., Aug. 14, 1902, *Baker* 1461 (B, P, MBG, ND, US, NY); Hunter's Creek, Washoe Co., elev. 6000 ft., Aug. 2, 1912, *P. P. Kennedy* 1916 (G, NY); Verdi, July 28, 1893, *Hillman* (P).

WASHINGTON: Bingen, Klickitat Co., steep mountainside, June 9, 1905, *Suksdorf* 5133 (MBG, US, G, NY); Waitsburg, May 29, 1897, *Horner* 334 (G); valley of the Swank River, Kittitas Co., May-Sept., 1913, *Sharples* 181 (G); Bingen, dry open forest, May 23, 1924, *Suksdorf* 11692 (G, W); Lake Chelan, Cascade Mts., alt. 1090 ft., July 1-Sept. 15, 1915, *Kammerer* 103

(MBG); Klamath Co., south side Devil's Peak, Cherry Creek Canyon, alt. 6500 ft., Aug. 15, 1909, *J. P. Rose* 1382 (MBG); Pullman, July 25, 1900, *Piper* 3508 (US, G).

OREGON: common in old fields and open hillsides, Hood River Co., May 18, 1924, *Henderson* 310 (MBG); five miles east of Union Creek, July 24, 1918, *Heller* 13067 (MBG, US, NY, G, F); Klamath Valley, alt. 4200 ft., 1864, *Cronkhite* 76 (US, MBG); The Dalles, alt. 100 ft., July 27, 1897, *M. E. Jones* (P); Josephine Co., near Stone Corral, west fork of Illinois River, July 1-3, 1922, *Abrams* 8629 (P); Takilma, Josephine Co., June 26, 1918, *Peck* 8004 (G); Swan Lake Valley, Klamath Co., July 8, 1896, *Applegate* 447 (G); Columbia Plains, *Nuttall* (G); Grant's Pass, June 5, 1912, *Prescott* (G).

CALIFORNIA: Hornbreck, Siskiyou Co., July 7, 1903, *Copeland* 3544 (P, MBG, US, G); Brush Creek, Butte Co., 1907, *Conger* (P); Hockett's Meadows, Tulare Co., July 1, 1904, *Culbertson* 4472 (MBG, G, P, US); San Bernardino Mts., north fork Deep Creek, alt. 6200 ft., under pines, July 17, 1921, *Johnston* 2871 (P); Bear Lake, San Bernardino Mts., June 24, 1926, *M. E. Jones* (P); Pine Grove, Amador Co., alt. 2200 ft., July 20, 1895, *G. Hanson* 938 (US, MBG, G, P, NY, F); Mt. Shasta and vicinity, Siskiyou Co., July 13-29, 1892, *E. Palmer* 2522 (P, US); Bear River, Amador Co., alt. 5500 ft., July 30, 1896, *G. Hanson* (P, US, MBG, G); Lake Tahoe, woods along shore, Aug. 4, 1920, *Keyes* (P); north fork Coffee Creek, Trinity Co., alt. 4500 ft., July 3, 1911, *Alexander & L. Kellogg* 209 (P); Mt. Silliman, Aug. 1905, *K. Brandegee* (P); Silver Lake, Amador Co., alt. 8000 ft., Oct. 1893, *G. Hanson* 969 (MBG, US); near Pit River Ferry, Shasta Co., alt. 700-900 ft., May 15-28, 1897, *H. E. Brown* (MBG, NY); between Meek's Bay and Emerald Bay, Lake Tahoe, July 30, 1919, *Heller* 13345 (MBG); Pine Ridge, Fresno Co., alt. 5300 ft., June 15-25, 1900, *Hall & Chandler* 146 (MBG, NY, ANSP); west of Bennett Springs, Glenn Co., June 16, 1915, *Heller* 11986 (MBG); Long Valley, June 7, 1869, *Kellogg & Harford* 4870 (MBG); Summit Station, Placer Co., date lacking, *Heller* 12887 (MBG); Lassen Creek, Modoc Co., 1894, *Austin* (ND); Davis Creek, Modoc Co., 1895, *Austin* (ND); Murphy's, Calaveras Co., May 15, 1887, *B. H. Smith* (ANSP); Modoc

Co., hillsides, red soil, July 12, 1893, *M. S. Baker* (ND, NY, MBG); Carver Creek, Aug. 4, 1882, *Austin* (ND); Blue Canyon, July 21, 1895, *Greene* (ND, US); Plumas Co., July, 1882, *Austin* (ND); Glen Alpine, Aug. 19, 1909, *McGregor* 32 (NY, US); Willits, Mendocino Co., July 7, 1923, *Heller* 13753 (NY); Rush Creek, Trinity Co., June, 1914, *Yates* (NY); Wolf Creek, Mendocino Co., July 7, 1916, *Abrams* 5865 (NY); Truckee, July 17, 1901, *Williamson* (ANSP).

2a. *Apocynum pumilum* (A. Gray) Greene var. *rhomboideum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 98. 1913.

Plate 10.

Apocynum rhomboideum Greene, Pittonia 5: 66. 1902.

Apocynum tomentellum Greene, Leafl. Bot. Obs. & Crit. 1: 58. 1904, *non* Nieuwl.

Apocynum androsaemifolium L. subsp. *detonsum* Piper, Contr. U. S. Nat. Herb. 11: 453. 1906.

Apocynum cinereum A. A. Heller, Muhlenbergia 8: 21. 1912.

Apocynum polycardium Greene, Leafl. Bot. Obs. & Crit. 2: 184. 1912.

Apocynum pulchellum Greene, l. c. 186. 1912.

Apocynum arcuatum Greene, l. c. 187. 1912.

Apocynum diversifolium Greene, l. c. 189. 1912.

Apocynum pumilum (A. Gray) Greene var. *intermedium* Bég. & Bel. l. c. 96. 1913.

Apocynum pumilum (A. Gray) Greene var. *tomentellum* (Greene) Bég. & Bel. l. c. 1913.

Apocynum molle Greene ex Bég. & Bel. l. c. 97. 1913, *nomen in synon.*

Apocynum ericifolium Greene ex Bég. & Bel. l. c. 1913, *nomen in synon.*

Apocynum pumilum (A. Gray) Greene var. *pulchellum* (Greene) Bég. & Bel. l. c. 98. 1913.

Plant variously tomentose or pubescent, in all other essential characters similar to the type.

Distribution: apparently limited to the Pacific Coast area of the United States.

Specimens examined:

IDAHO: about Lake Waha, Nez Perces Co., alt. 3500-4000 ft., June 29, 1896, *Heller & Heller* 3338 (MBG, US, NY).

NEVADA: King's Canyon, Ormsby Co., alt. 1700-2000 m., July 1, 1902, *Baker* 1209 (MBG, P, US, G, NY, ND, F, W); Clear Creek, Ormsby Co., alt. 2000-2615 m., July 3, 1902, *Baker* 1252, in part (P).

WASHINGTON: locality missing, 1889, *Vasey* 429 (G, W); Falcon Valley, open woods, July 19, Sept., 1886, *Suksdorf* (G, US, NY); Bingen, dry mountain-sides, June 9, 1905, *Suksdorf* 5134, in part (G, US, MBG); Mt. Ellinor, Olympia Mts., Aug., 1910, *Zeller* (MBG); top, Mt. Constitution, July 5, 1907, *Cowles* 380 (MBG); Lake Washington, King Co., June 20-July 12, 1898, *Savage, Cameron & Lenocker* (MBG); prairie, Sequim, June 12, 1915, *Grant* (MBG, NY).

OREGON: Wimer, Jackson Co., July 14, 1892, *Hammond* 274 (P, US, ANSP); two miles north of Mt. Hood post-office, Hood River Co., July 25-28, 1922, *Abrams* 9338 (P); Big Butte Creek, Josephine Co., Sept. 3, 1917, *Heller* 12963 (G, MBG, NY, F); Anchor, Douglas Co., Aug. 14, 1916, *Peck* 2945 (G, US); locality and date lacking, *Hooker* (G); Salem, July 8, 1917, *J. C. Nelson* 1594 (G); Port Oxford, dry ridge, Bald Mt., July 26, 1919, *Peck* 8944 (G, MBG, NY); Columbia Plains, date lacking, *Nuttall* (G); Hillsboro, Dairy Creek Valley, railroad tracks, July 11, 1915, *H. H. Smith* 6013 (F); locality lacking, 1871, *E. Hall* 427 (G, MBG); near the Dalles on the Columbia River, Aug. 16, 1916, *Soper* (MBG).

CALIFORNIA: Alder Springs, Glenn Co., July 4, 1917, *Heller* 12753 (G, MBG); Palomar Mt., San Diego Co., alt. 5000 ft., June 22, 1924, *Munz* 8274 (P, G); Yosemite Valley, June 30, 1911, *Abrams* 4580 (G, P); Thistle Glade, Lake Co., Aug. 6, 1902, *Heller* 6036 (G, P, US); Glenn Co., June 16, 1915, *Heller* 11978 (G, MBG, NY, ANSP, US, F); Fredalba, San Bernardino Co., July 22, 1902, *Abrams* 2775 (US, G, P, ANSP, F, MBG); Mt. Sanhedrin, near the summit, Lake Co., July 20, 1902, *Heller* (US, G); Sisson, Siskiyou Co., Nov. 12, 1913, *L. E. Smith* 571 (G); above Donner Lake toward Donner Pass, Nevada Co., July 29, 1903, *Heller* 7050 (P, NY, ANSP, US, MBG); Diamond Mt., Susanville, Perkin's Ranch, alt. 6000-7000 ft., June 28,

1897, *M. E. Jones* (P); dry slopes, Palomar Mt., San Diego Co., alt. 5000 ft., *Munz* 8274 (P); Soda Springs, Nevada Co., alt. 7000 ft., July, 1881, *M. E. Jones* (P); Lassen Co., July 30, year lacking, *Austin* 1458 (US); Smith Mt., San Diego Co., July 5, 1896, *McClatchie* (NY); south fork of the Eel River, July 8, 1892, *Jepson* (ND); Mt. Hamilton, July, 1891, *Greene* (ND).

3. *Apocynum medium* Greene, Pittonia 3: 230. 1897; G. S. Miller, Proc. Biol. Soc. Wash. 13: 84. 1899; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Stone, Pl. South. N. J. 646. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 121. 1913; Britton & Brown, Ill. Fl. ed. 2, 3: 21. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. 21: 230. 1919; Pease, Vasc. Fl. Coös Co. N. H. 324. 1924. Plate 11.

Apocynum speciosum G. S. Miller, Proc. Biol. Soc. Wash. 13: 83. 1899; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 122. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. 21: 230. 1919.

Apocynum urceolifer G. S. Miller, l. c. 1899.

Apocynum androsaemifolium Holm ex G. S. Miller, l. c. 1899, non L.

Apocynum Milleri Britton, Man. Pl. 739. 1901; Britton & Brown, Ill. Fl. ed. 2, 3: 22. 1913.

“*Apocynum medium* G. S. Miller,” ex Britton, Man. Pl. 739. 1901, non Greene.

Apocynum divergens Greene, Leafl. Bot. Obs. & Crit. 1: 56. 1904.

Apocynum Andrewsii Greene, l. c. 57. 1904.

Apocynum abditum Greene, l. c. 2: 105. 1910.

Apocynum insigne Greene, l. c. 178. 1912.

Apocynum ellipticum Greene, l. c. 179. 1912.

Apocynum Elmeri Greene, l. c. 181. 1912.

Apocynum pumilum (A. Gray) Greene var. *Milleri* (Britton) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 96. 1913.

Apocynum macrophyllum Bég. & Bel. l. c. 123. 1913.

Apocynum pseudomedium Bég. & Bel. l. c. 124. 1913.

Apocynum lividum Greene var. *Elmeri* (Greene) Bég. & Bel. l. c. 127. 1913.

Apocynum lividum Greene var. *abditum* (Greene) Bég. & Bel. l. c. 128. 1913.

Apocynum androsaemifolium L. var. *Andrewsii* (Greene) Bég. & Bel. *l. c.* 85. 1913.

Apocynum androsaemifolium L. var. *oblongifolium* Bég. & Bel. *l. c.* 85. 1913. *nomen in synon.*

Apocynum coconinum Greene ex. Bég. & Bel. *l. c.* 129. 1913. *nomen in synon.*

Apocynum viride Wooton & Standl. Contr. U. S. Nat. Herb. 16: 159. 1913.

Apocynum Milleri Britton var. *pauciflorum* Farwell, Rept. Mich. Acad. Sci. 17: 170. 1916.

Stems erect or ascending, 2-5 dm. tall, freely and rather dichotomously branched, branches ascending, alternate to subopposite, glabrate; leaves opposite, petiolate to subsessile, spreading, ovate to oblong-lanceolate, acute to obtuse at base and apex, or cordate-ovate, membranaceous, entire, mucronate, pubescent or tomentulose, at least beneath; corolla campanulate, 4-5 mm. long, 3.5-5 mm. broad at the orifice, the base of the tube less than one-half the breadth of the limb, the limb slightly spreading, calyx-lobes lanceolate to oblong, 1.5-3 mm. long, tomentulose or glabrate, colorless or slightly tinted; follicles 7-15 cm. long, straight, divergent, or somewhat falcate, pendulous, coma of seeds 2 cm. long, pale tawny, seeds cylindrical, 4 mm. long.

Distribution: generally throughout the range of *A. androsaemifolium*.

Specimens examined:

NEWFOUNDLAND: ledges, talus and gravel, north bank of Exploits River, below Bishop Falls, July 28, 1911, *Fernald & Wiegand* 6090 (G); Grand Falls, July 27, 1911, *Fernald & Wiegand* 6089 (G).

CANADA:

NOVA SCOTIA: slaty ledges and cobbly upper beach of Shubenacadie, Grand Lake, July 19, 1920, *Fernald & Bissell* 22316 (G); Wentzell Lake, Aug. 17, 1921, *Fernald & Long* 24392 (G).

NEW BRUNSWICK: sandy river bank, Westfield, Aug. 8, 1909, *Fernald* 2075 (G); gravelly river thickets and bushy terraces, Woodstock, July 14, 1916, *Fernald & Long* 14400 (G).

QUEBEC: Matapedia, ledgy banks of the Restigouche River, July 19, 1904, *Collins & Fernald* (G); Grand Cascapedia River,

alluvium, July 12-15, 1904, *Williams, Collins & Fernald* (G); Saint-Laurent; remblai du chemin de fer, Juillet 5, 1926, *Adrien 1094* (G); Grande Rapide, River Ste. Anne des Monts, Aug. 3-17, 1905, *Collins & Fernald* (G).

UNITED STATES:

MAINE: Fort Fairfield, alluvial thicket, July 16, 1902, *Williams, Collins & Fernald* (G); Fort Kent, July 24, 1900, *Williams* (G, US); Orne Falls, in granite ledges, July 17, 1900, *Williams & Fernald* (G, MBG, US); Rumford, 1889, *Parlin* (G); Van Buren, dry wooded bank, July 26, 1893, *Fernald* (G); river-beach below Fort Kent, July 15, 1908, *Churchill* (NE); Grand Falls, east branch of the Penobscot River, July 28, 1857, *Hoar* (NE); argillaceous ledges by river, Winn, July 10, 1916, *Fernald & Long 14399* (NE, ANSP); Orono, 1880, *Furbish* (NE); East Livermore, bank of the Androscoggin River, July 26, 1901, *Eaton* (NE).

NEW HAMPSHIRE: Dalton, gravelly shore of Connecticut River, July 7, 1919, *Pease 17383* (NE).

VERMONT: Westminster, open ground, sandy soil, June 16, 1898, *B. L. Robinson 11* (G); Willoughby, July 11, 1895, *G. G. Kennedy* (NE); Westmore, Aug. 1919, *Winslow* (NE); Swanton, Franklin Co., alt. 125 ft., Aug. 17, 1911, *Blake 2844* (NE); Brattleboro, July 10, 1916, *Wheeler 2* (NE).

MASSACHUSETTS: Edgartown, Martha's Vineyard, June 22, 1913, *Bicknell* (NY); river-bank, Shelburne Falls, Franklin Co., July 21, 1921, *Churchill* (MBG, G, NY, US); South Framingham, July 30, 1908, *Wiegand & Hentley* (NE); Dorchester, July 15, 1899, *Churchill* (NE); Brewster, dry woods near Namskaket Creek, July 22, 1919, *Fernald & Long 19008* (G, ANSP); West Yarmouth, brook-side, Aug. 1, 1907, *Sinnott* (NE); Great Barrington, July 17, 1920, *Hoffmann* (NE); West Tisbury, Sept. 5, 1917, *Seymour 1431* (NE); Wilmington, bridge at canal crossing, July 22, 1910, *G. G. Kennedy* (G).

RHODE ISLAND: Scituate, July 21, 1920, *Collins & Hope* (NE); Block Island, Great South Pond, Aug. 22, 1913, *Fernald, Hunnewell & Long 10243* (NE).

CONNECTICUT: New Haven, 1859, *Eaton* (MBG); Groton, Poquomoc Plain, Aug. 16, 1903, *Graves* (G); Southington, Whitney's Garden, July 4, 1904, *Andrews* (NE); Southington,

sandy loam in open grass-land, Aug. 1, 1902, *Andrews* (NE, US); Killingly, dry rock ledges, June 22, 1902, *Bissell* (NE); New London, July 5, 1903, *Graves* (G); Westport, July 1, 1914, *Eames* 8786 (G); South Windsor, roadside in heavy soil, July 21, 1918, *Weatherby* 4324 (NE).

NEW YORK: Lime Kiln Falls, July 6, 1906, *Rydberg* 7892 (NY); Deerfield, banks of the Mohawk River, Oneida Co., July 18, 1912, *Haberer* 3559 (ND, NY); Ithaca, Six Mile Creek, July 21, 1915, *Eames & McDaniels* 4832 (G); Penn Yan, date lacking, *Sartwell* (G); Hempstead, July 3, 1904, *Churchill* (G, US); Riverhead, dry sandy roadside, July 27, 1920, *H. St. John* 2880 (G).

NEW JERSEY: New Brunswick, July, 1891, *G. G. Kennedy* 50 (G); Newton, July 14, 1907, *Carter* (ANSP); Culver's Gap, July 12, 1907, *Williamson* (ANSP).

PENNSYLVANIA: mountain near Reading, Aug. 6, 1909, *Williamson* (ANSP); Morrisville, July, 1892, *Kelsey* 158 (G); Cove Valley, Aug., 1824, *Beyerich* (MBG); Mt. Alto, 1909, *Illick* (MBG).

MARYLAND: Capitol View, Montgomery Co., June 21, 1899, *Miller* 2 (G, US); Capitol View, July 2, 1899, *Miller* 1 (G, US); Sligo, July 9, 1899, *Miller* 3 (G, US).

DISTRICT OF COLUMBIA: Washington, July 23, 1898, *Steele* (G); Brookland, abundant in low grounds, July 4, 1893, *Holm* (G, US); Brookland, July 3, 1909, *Greene* (ND, US).

VIRGINIA: Chain Bridge, July 14, 1899, *W. Palmer* (US); near Coral, Fairfax Co., Aug. 14, 1905, *Bartsch* (MBG).

FLORIDA: Lake City, date lacking, *Rolfs* 720 (MBG).

OHIO: near Cincinnati, July 17, 1882, *Lloyd* (MBG).

MICHIGAN: Detroit, hillsides, June, 1904, *Farwell* (US); Ionia, 1877, *E. F. Smith* (G); between Battle Creek and Jackson, on roadside banks in clay soil, Aug. 22, 1926, *Heller* 14261 (MBG).

INDIANA: Lake Cicott, July 22, 1915, *Deam* 17879 (G, US, NY, D); Notre Dame, Indian Grove, Oct. 8, 1913, *Nieuwland* 11602 (MBG, F); St. Joe, June 29, 1916, *Deam* 21571 (G, D); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland*, *Slavin & Woodson* 1 (MBG); in dry soil along the right-of-way of the Penna. Railroad, 2 mi. east of

Burnettsville, Cass Co., July 9, 1918, *Deam* 25904 (D); Warren Co., along road 2 mi. southeast of Williamsport, Aug. 1, 1912, *Deam* 11902 (D); Blackford Co., Washington Tp., Sec. 30, on west side of swale, northeast of glycerine factory, July 16, 1905, *Deam* 73 (D); Tippecanoe Co., near Lafayette, very common along Wabash Ry., July 4, 1901, *H. B. Dorner* (D); wooded slope of Elizabeth Hill, about 3 mi. east of Elizabeth, Harrison Co., June 11, 1919, *Deam* 27862 (D); moist woods on north side of Lake Wawasee, Kosciusko Co., June 22, 1908, *Deam* (D).

ILLINOIS: Peoria, July, 1903, *McDonald* (NY).

TENNESSEE: Franklin, Cumberland Mt., July 21, 1897, *Eggert* (MBG).

IOWA: Muscatine, July 14, 1894, *Mackenzie* (NY).

MISSOURI: Ethel, June 12, 1915, *Bush* 7615 (NY, MBG); Mansfield, alt. 1450 ft., June 12, 1911, *Lansing* 3183 (G, F); Joplin, rocky wooded hillsides, *E. J. Palmer* 18293 (NY, MBG); Vernon Co., date lacking, *Broadhead* (MBG); Montier, common, June 30, 1894, *Bush* 338 (MBG).

NEBRASKA: Monroe Canyon, June 20, 1911, *Pool & Williams* (MBG).

TEXAS: exact locality lacking, March 28, 1874, *Reverchon* (MBG); on gravel-bank of stream, near Boot Spring, Chisos Mts., Brewster Co., May 25, 1928, *E. J. Palmer* 3418a (MBG).

NEW MEXICO: exact locality lacking, 1847, *Fendler* 690.6 (MBG); Lincoln Co., White Mts., Aug. 25, 1907, *Wooton & Standley* 3451 (US); infrequent, sandy soil, Flagstaff, alt. 7000 ft., Aug. 11, 1922, *H. C. Hanson* 158 (MBG).

3a. *Apocynum medium* Greene var. *sarniense* (Greene) Woodson, n. comb.

Apocynum Sarniense Greene, Leafl. Bot. Obs. & Crit. 2: 167. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 123. 1913.

Apocynum griseum Greene, l. c. 181. 1912.

Apocynum androsaemifolium L. var. *griseum* (Greene) Bég. & Bel. l. c. 87. 1913.

Corolla hirtellous without; upper surface of leaves softly pubescent, or occasionally glabrate; in all other essential characters similar to the species.

Distribution: apparently a spontaneous variety, collected in southwestern Ontario, southeastern Michigan, northern Indiana, and southern British Columbia.

Specimens examined:

CANADA:

ONTARIO: Sarnia, Lambton Co., Aug. 3, 1902, *Dodge* (US).

BRITISH COLUMBIA: near international boundary between Kettle and Columbia Rivers, June 6, 1902, *Macoun* 66555 (US, ND).

UNITED STATES:

MICHIGAN: Detroit, July 13, 1889, *Suttie* (MBG).

INDIANA: sandy roadside 9 mi. west of Howe, La Grange Co., Sept. 21, 1916, *Deam* 20972 (D); in hard clay soil along a roadside, 1 mi. north of Poling, Jay Co., July 19, 1923, *Deam* 39168 (D); on the break of a bluff in a deep white and black oak woods about 1 mi. northwest of St. Joe, Clark Co., June 29, 1916, *Deam* 20571 (D).

3b. *Apocynum medium* Greene var. *leuconeuron* (Greene) Woodson, n. comb.

Apocynum leuconeuron Greene, Leafl. Bot. Obs. & Crit. 2: 178. 1912.

Plant glabrous throughout, calyx-lobes oblong to ovate, abruptly acute, colorless; in all other essential characters similar to the species.

Distribution: the upper Mississippi Valley, eastward to southern Michigan and northern Indiana.

Specimens examined:

UNITED STATES:

MICHIGAN: peat swamp—Tamarack, *Lilium michiganense*, etc.,—Flowerfield, south of Schoolcraft, July 14, 1929, *E. Anderson* (MBG).

INDIANA: sandy roadside 3 mi. southwest of Elkhart, Elkhart Co., July 2, 1921, *Deam* 34434 (D).

WISCONSIN: Oshkosh, July 30, 1909, *Clemens* (P).

MISSOURI: Clarksville Depot, Pike Co., June 16, 1914, *J. Davis* 2263 (MBG); Jackson Co., clayey hills, only found near Little Blue as yet, June 24, 1884, *Bush* 916 (MBG, US); Jerome, May

24, 1914, *Kellogg* 471 (MBG); east of Mt. Olivet Cemetery, Hannibal, Marion Co., waste fields, July 21, 1914, *J. Davis* 2969 (MBG); Cockerell, July 3, 1898, common in barrens, *Bush* 11 (MBG, US); Hannibal, Marion Co., Aug. 21, 1914, ravine, *J. Davis* 2947 (MBG); Jackson Co., loose sand-banks, July 3, 1898, *Mackenzie* 200 (MBG, NY); northeast corner of Mt. Olivet Cemetery, Hannibal, Marion Co., July 23, 1927, *Woodson & Fuller* 1653 (MBG); Clarksville, Pike Co., railroad bank, opposite station, July 23, 1927, *Woodson & Fuller* 1696 (MBG).

3c. *Apocynum medium* Greene var. *floribundum* (Greene)
Woodson, n. comb. Plate 12.

Apocynum floribundum Greene, *Erythea* 1: 151. 1893.

Apocynum viarum Heller, *Muhlenbergia* 2: 110. 1906.

Apocynum cannabinum L. var. *lividum* A. Nels. in Coulter & Nels. *New Man. Bot. Rocky Mts.* 386. 1909.

Apocynum glaucum Nieuwl. *Am. Mid. Nat.* 2: 181. 1912.

Apocynum vacillans Greene, *Leafl. Bot. Obs. & Crit.* 2: 180. 1912.

Apocynum rubicundum Greene, *l. c.* 182. 1912.

Apocynum pumilum (A. Gray) Greene var. *rubicundum* (Greene) Bég. & Bel. *Atti R. Accad. Lincei*, V. 9: 127. 1913.

Apocynum lividum Greene var. *vacillans* (Greene) Bég. & Bel. *l. c.* 127. 1913.

Apocynum lividum Greene var. *floribundum* (Greene) Bég. & Bel. *l. c.* 128. 1913.

Apocynum lividum Greene var. *viarum* (Heller) Bég. & Bel. *l. c.* 129. 1913.

Plant completely glabrous; corolla cylindrical, the tube conspicuously longer than the spread of the limb; in all other essential characters similar to the species.

Distribution: Colorado and westward in the United States.

UNITED STATES:

TEXAS: Guadalupe Mts., Aug. 19, 1901, *Bailey* 444 (US); moist banks about spring, Juniper Canyon, Chisos Mts., Brewster Co., May 22, 1928, *E. J. Palmer* 34081 (MBG).

MONTANA: bluffs, Midvale, July 14, 1903, *Umbach* 371 (US, NY);

Mecksville, in the Clarkes Fork Valley, Aug. 22, 1895, *Leiberg* (US, MBG); Spanish Creek, Gallatin Co., 1901, *Vogel* (G); Ravalli, July 14, 1909, *M. E. Jones* (P).

WYOMING: rolling plains between Sheridan and Buff, elev. 3500-5000 ft., July 15, 1900, *Tweedy* 3475 (W).

COLORADO: Piedra, July 11, 1899, *Baker* 526 (G, US, NY); Clear Creek Canyon, June 20, 1878, *M. E. Jones* 237 (P); Clear Creek Canyon, July 18, 1896, *Crandall* (NY); in loose clay, Boulder, Boulder Co., June 27, 1913, *Vestal* (MBG); plains, Boulder, alt. 5400 ft., July 19, 1906, *Daniels* 409 (MBG); common in woods along creek, Boulder, alt. about 5300 ft., Aug. 2, 1921, *H. C. Hanson* 277 (MBG); base of Palisade Mt., Larimer Co., alt. 8000 ft., Aug. 10, 1927, *Woodson* 1809 (MBG); among rocks below Eagle Cliffs, Moraine Park, Larimer Co., July 25, 1929, *Woodson & Barnhart* 29030 (MBG).

NEW MEXICO: Round Mound, June 19, 1846, *Wislizenus* 496 (MBG); Ute Park, Colfax Co., Aug. 29, 1916, *Standley* 13989 (NY, US); Copper Mines, July, 1851, *Thurber* 222 (NY); in the Organ Mts., Dona Ana Co., alt. 6300 ft., July 8, 1897, *Wooton* 113 (MBG, US).

IDAHO: Weeksville, Clarkes Fork Valley, alt. 650 m., Aug. 22, 1895 (labelled "*Chrysopsis villosa* (Pursh) Nutt."), *Leiberg* 1565 (MBG, G); Lake Coeur d'Alene, Aug. 3-4, 1925, *Epling & Houck* 10004 (Epling Herb.); Clearwater, date lacking, *Epling & Houck* 9402 (Epling Herb.); Bonner's Ferry, Aug. 30, 1926, *Epling* 10461 (Epling Herb.).

UTAH: Moab, June 9, 1913, *M. E. Jones* (P); Parley's Canyon, June 17, year lacking, *Garrett* 2915 (NY).

ARIZONA: Ft. Apache, June, 1893, *Hoyt* (NY); Flagstaff, vicinity, alt. 7000 ft., July 8, 1898, *MacDougal* 254 (G); frequent, sandy places west of Flagstaff, June 27, 1923, *Hanson* 585 (MBG); Williams, July 5, 1889, *Greene* (ND).

NEVADA: King's Canyon, Ormsby Co., Aug. 20, 1902, *Baker* 1508 (MBG, G, US, NY, F); same locality, July 3, 1902, *Baker* 1220 (P, MBG); mountains west of Carson, Washoe Co., July 13, 1909, *Heller* 9815 (MBG, G, NY, US); Verdi, elev. 5300 ft., Washoe Co., June 30, 1913, *Heller* 10883 (NY).

WASHINGTON: locality lacking, 1889, *Vasey* 430 (G, US, W); among rocks, rare, Guy, Whitman Co., July 18, 1896, *Elmer* 285 (MBG, US, P, W); Peshastin, Okanogan Co., 1500 ft., July 25, 1893, *Sandberg & Leiberg* 591 (W); near Wenatchee, Aug. 11, 1901, *Whited* 1423 (W).

OREGON: dry soil along railroad, 1 mile south of Brooks, Marion Co., June 29, 1918, *J. C. Nelson* 2284 (G); Rogue River, Aug. 27, 1897, *Austin* 1683 (P); dry slope, Canyon City, July 12, 1921, *Peck* 10172 (P).

CALIFORNIA: near Healdsburg, June, 1897, *King* 247 (P); Nevada City, July 14, 1905, *Heller* 8110 (MBG, G, US, NY, W); Goose Valley, Shasta Co., June 29, July 11, 1912, *Eastwood* 906 (G, MBG, US); Yosemite Valley, alt. 4000–4500 ft., July 9, 1911, *Abrams* 4650 (G); Mt. Tallac, Tahoe, alt. 8600 ft., July 19, 1913, *Smiley* 247 (G); Nevada City, Nevada Co., June 20–22, 1912, *Eastwood* 542 (MBG); Amador Co., alt. 2000 ft., July, 1891, *G. Hanson* 27 (MBG); Tehachapi, June 22, 1889, *Greene* (US, ND).

MEXICO: near Colonia Garcia, June 23, 1899, *Townsend & Barber* (US); in the Sierra Madre, Chihuahua, June 21–July 29, 1899, *E. W. Nelson* 6012 (US).

3d. *Apocynum medium* Greene var. *lividum* (Greene) Woodson, n. comb.

Apocynum lividum Greene, Pl. Baker. 3: 17. 1901; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2: 193. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 125. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 505. 1915; Rydb. Fl. Rocky Mts. 669. ed. 2. 1917; Tidestrom, Contr. U. S. Nat. Herb. 25: 419. 1925.

Apocynum ciliolatum Piper, Contr. U. S. Nat. Herb. 11: 453. 1906; Frye & Rigg, Northwest. Fl. 308. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 130. 1913; Piper & Beattie, Fl. S. E. Wash. 194. 1914.

Apocynum lividum Greene var. *typicum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 95. 1913.

Apocynum denticulatum Suksdorf, Werdenda 1: 31. 1927.

Plant glabrous except the under surface of the leaves; calyx-

lobes ciliate-erose; in all other essential characters similar to the species.

Distribution: Colorado and northern New Mexico, westward to Washington and California.

Specimens examined:

COLORADO: Black Canyon, alt. 6800 ft., July 8, 1901, *Baker* 372 (G, MBG, US, NY, P, W); Mancos, July 9, 1898, *Baker, Earle & Tracy* 429 (G, MBG, US, NY, P); stream banks, North St. Vrain Canyon, near "the Narrows," Larimer Co., July 25, 1929, *Woodson & Barnhart* 29028 (MBG); stream banks, near mouth of North St. Vrain Canyon, west of Lyons, July 9, 1929, *Woodson & Anderson* 29001 (MBG); flourishing in cultivated fields and irrigation ditches, Bayfield, La Plata Co., June 27, 1929, *Woodson & Anderson* 29007 (MBG).

NEW MEXICO: along roadsides, near summit of Raton Pass, June 30, 1929, *Mathias* 536 (MBG).

WASHINGTON: Wawawai, July 17, 1892, *Lake & Hull* 542 (US); Rockland, on steep dry hillside near a small stream, June 8, 1904, *Suksdorf* 4049 (G, W).

CALIFORNIA: Yosemite Valley, alt. 4000-4500 ft., June 28, 1911, *Abrams* 4549 (P); Big Bear Valley, pine-covered hillside, alt. 7000 ft., July 5, 1920, *Harwood* 4328 (P).

3e. *Apocynum medium* Greene var. *vestitum* (Greene) Woodson, n. comb. Plate 13.

Apocynum vestitum Greene, Man. Bay Region Bot. 240. 1894; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 131. 1913.

Apocynum incanum Greene, Leafl. Bot. Obs. & Crit. 2: 164. 1911; Bég. & Bel. l. c. 130. 1913. *non* (A. DC.) G. S. Miller.

Entire plant pubescent; corolla cylindrical; calyx-lobes entire; in all other essential characters similar to the species.

Distribution: southern Oregon and north-central California.

Specimens examined:

OREGON: Rogue River, Bolt, Jackson Co., July 8, 1892, *Hammond* 275 (MBG, US, NY).

CALIFORNIA: St. Helena, July, 1891, *Greene* (ND, US); Napa Co., dry creek, May 12, 1895, *Greene* (ND, US).

4. *Apocynum Jonesii* Woodson, n. sp.⁹⁷

Plate 14.

Stems erect or somewhat ascending, 5–6 dm. tall, freely and somewhat fastigiately branched, the branches opposite to subopposite, glabrous throughout; leaves relatively small, petiolate, lanceolate-oblong, 3–5 cm. long, 1–2 cm. broad, acute at base and apex, membranaceous, entire, mucronate; inflorescence strictly cymose, few-flowered, terminal, or rarely axillary; corolla cylindrical, 2.5–3 mm. long, 2 mm. broad at the orifice, the base of the tube about equalling the breadth of the orifice, limb erect, glabrous; calyx-lobes ovate, .75–1.0 mm. long, glabrous, entire, pinkish; follicles unknown.

Distribution: known only from the type locality in Arizona.

Specimen examined:

ARIZONA: Flagstaff, Aug. 12, 1884, *M. E. Jones* (P, TYPE).

This species, which is most nearly related to *A. Suksdorffii*, is very distinct by reason of its calyx and its corolla, as set forth in the preceding key to the species of the genus. It is dedicated to Professor Marcus E. Jones, the collector of the type specimen.

5. *Apocynum Suksdorffii* Greene, Pittonia 5: 65. 1902; Piper, Contr. U. S. Nat. Herb. 11: 453. 1906; Frye & Rigg, Northwest Fl. 308. 1912.

Plate 15.

Apocynum laurinum Greene, l. c. 1902; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 129. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 506. 1915.

Apocynum oliganthum Greene, Leafl. Bot. Obs. & Crit. 1: 58. 1904.

Apocynum myrianthum Greene, l. c. 59. 1904.

Apocynum cannabinum L. var. *oliganthum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 104. 1913.

Apocynum cannabinum L. var. *Suksdorffii* (Greene) Bég. & Bel. l. c. 105. 1913.

Apocynum hypericifolium Ait. var. *myrianthum* (Greene) Bég. & Bel. l. c. 118. 1913.

⁹⁷ *Apocynum Jonesii*, sp. nov., herbaceum perenne; caule erecto vel ascendente ramoso striato omnino glabro; foliis oppositis petiolatis membranaceis oblongo-lanceolatis, mucronatis petiolatis; calycis lobis ovatis ca. 1 mm. longis; corolla cylindrica, tubo 2.5–3 mm. longo, limbo 5-partito, ca. 2 mm. lato folliculis ignotis.—Collected near Flagstaff, Arizona, Aug. 12, 1884, *M. E. Jones* (Pomona College Herb., TYPE).

Apocynum hypericifolium Ait. var. *pseudosuksdorfii* Bég. & Bel. l. c. 118. 1913.

“*Apocynum Suksdorffii* Elm. non Greene” ex Bég. & Bel. l. c. 1913, *nomen in synon.*

Stems erect or slightly ascending, 4–6 dm. tall, glabrous throughout, freely and somewhat fastigiately branched, the branches opposite to subopposite; leaves opposite, petiolate, oblong-ovate, 4–8 cm. long, 1.5–2.5 cm. broad, acute at both base and apex, membranaceous, entire, mucronate; corolla cylindrical, 2–3.5 mm. long, about 1.5–2 mm. broad at the orifice, the base of the tube about equaling the breadth of the orifice, limb erect; calyx-lobes lanceolate to oblong, 1–1.5 mm. long, entire, colorless or slightly tinted; follicles 9–10 cm. long, falcate, pendulous, seed 3.5–4 mm. long, coma of seed 2–2.5 cm. long, slightly tawny.

Distribution: generally throughout the Pacific Coast region, eastward to New Mexico and southern Colorado.

Specimens examined:

COLORADO: New Windsor, Aug. 8, 1898, *Osterhout* (NY); steep rocky banks of Mancos River opposite mouth of Johnson's Canyon, Southern Ute Indian Reservation, Montezuma Co., June 27, 1929, *Woodson & Anderson* 29075 (MBG).

UTAH: Salt Lake City, July 16, 1880, alt. 4300 ft., *M. E. Jones* 1863 (P).

NEVADA: King's Canyon, Ormsby Co., alt. 1700–2000 m., Aug. 20, 1902, *Baker* 1508, in part (MBG, P); Humboldt Canyon, West Humboldt Mountains, Humboldt Co., elev. 5100 ft., July 31, 1912, *Heller* 10612 (MBG, G, NY, F); Wadsworth, July 26, 1919, *Tidestrom* 10727 (G, US); Palisade, Elko Co., elev. 5066 ft., Aug. 11, 1909, *Heller* 9940 (G).

ARIZONA: Navajo Reservation, Nitsie C., a few dense patches, July, 1916, *Vorhies* 44 (G, MBG, US, NY); Chevron, w. of Holbrook, July 10, 1896, *Leick* (MBG); Reservoir Canyon, Painted Desert, plentiful, July 25, 1920, *Clute* 87 (G, US); Willow Spring, June 10–20, 1890, *E. Palmer* 511 (G).

WASHINGTON: Klickitat Co., high sandy bank of Columbia River, July 22, 1893, *Suksdorf* 1522 (G, MBG, US, F); Wenatchee, date lacking, *Whited* (W); North Yakima, Aug., 1895, *Watt* (W).

OREGON: on rocks in North Fork of Umpqua River, between Rock Creek and Steamboat Creek, alt. 900-1200 ft., *Elmer* (US).

CALIFORNIA: Waysides, Palomar Mt., San Diego Co., alt. 5600 ft., Aug. 14, 1918, *Spencer* 995 (G, P).

5a. *Apocynum Suksdorffii* Greene var. *angustifolium* (Wooton) Woodson, n. comb.

Apocynum angustifolium Wooton, Contr. U. S. Nat. Herb. 16: 159. 1913; Wooton & Standl. Contr. U. S. Nat. Herb. 19: 506. 1915.

Apocynum hypericifolium Ait. var. *angustifolium* (Wooton) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 120. 1913.

Apocynum pseudolaurinum Bég. & Bel. var. *typicum* Bég. & Bel. l. c. 1913, *nomen*.

Leaves lanceolate to linear-lanceolate; in all other essential characters similar to the species.

Distribution: New Mexico and southeastern Utah.

Specimens examined:

NEW MEXICO: Gila River bottoms, near Cliff, Grant Co., June 13, 1903, *Metcalfe* 132 (MBG, G, US, NY); Mimbres, Grant Co., July 1, 1904, *Metcalfe* 1070 (G, MBG, P, US); near Pecos, San Miguel Co., alt. 6700 ft., Aug. 18, 1908, *Standley* 5044 (MBG, US).

UTAH: San Juan River, July 14, 1895, *Eastwood* 71 (G).

6. *Apocynum cannabinum* L. Sp. Pl. ed. 1, 213. 1753; Michx. Fl. Bor. Am. 1: 121. 1803; Pursh, Fl. Am. Sept. ed. 1, 1: 179. 1814; Hook. Fl. Bor.-Am. 1: 51. 1840; A. Gray, Bot. Cal. 1: 473. 1876; Coulter, Man. Bot. Rocky Mts. 237. 1885; A. Gray, Syn. Fl. N. Am. 2¹: 82. 1886; Chapm. Fl. South. U. S. ed. 3, 341. 1897; Howell, Fl. N. W. Am. 1: 439. 1901; Piper, Contr. U. S. Nat. Herb. 11: 453. 1906; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Small, Fl. Southeast. U. S. ed. 2, 936. 1913; Britt. & Brown, Ill. Fl. ed. 2, 3: 22. 1913; Rydb. Fl. Rocky Mts. ed. 2, 668. 1917; Tidestrom, Contr. U. S. Nat. Herb. 25: 420. 1925; Garrett, Spring Fl. Wasatch Region, 120. 1927.

Plate 16.

Apocynum platyphyllum Greene, Leafl. Bot. Obs. & Crit. 2: 166. 1912.

Apocynum cannabinum L. var. *puberulum* Bég. & Bel. *Atti R. Accad. Lincei*, V. 9: 101. 1913.

Apocynum cannabinum L. var. *incanum* Bég. & Bel. *l. c.* 1913.

Cynopaema cannabinum (L.) Lunell, *Am. Mid. Nat.* 4: 509. 1916.

Stems erect or ascending, 3-6 dm. tall, glabrous, freely and somewhat fastigiately branched, branches ascending, opposite to sub-opposite; leaves opposite, petiolate, ovate to lanceolate, 4-10 cm. long, 1.5-4 cm. broad, acute to obtuse or rounded at both base and apex, membranaceous, entire, mucronate, glabrous above, tomentulose or pubescent beneath; inflorescence terminal, the bracts scarious, inconspicuous; corolla sphaerico-cylindrical, about as broad as long, 2-3 mm. long, 2-2.5 mm. broad, the limb erect; calyx-lobes lanceolate to ovate-oblong, 1.5-2 mm. long, entire, glabrous, scarious; follicles relatively long and subfalcate, 12-20 cm. long, pendulous, seeds 4-5 mm. long, coma of seed 2.5-3 cm. long, white.

Distribution: generally throughout the eastern half of the United States, infrequent in New England; a common field and roadside weed in the central states.

Specimens examined:

VERMONT: banks of Connecticut River, cove below Bradford, Aug. 18, 1927, *Mathias 275* (MBG).

MASSACHUSETTS: Plymouth, date lacking, *Oakes* (G); Nonquit, July 14, 1888, *Sturtevant* (MBG); Chestnut Hill, Easton, *Porter* (US).

RHODE ISLAND: Smithfield, July 23, 1845, *Olney* (G).

CONNECTICUT: Bridgeport, July 8, 1895, *Eames* (G, US); Southington, sandy fields, frequent, July 10-Aug. 25, 1899, *Bissell* (NE); Stratford, July 25, 1894, *Eames* (NE); Milford, Aug. 9, 1893, *Eames* (NE); New Haven, 1859, *Eaton* (US).

NEW YORK: near Syracuse, 1891, *Straub* (US); Valley Head, July 18, 1898, *Ruth 501* (US).

PENNSYLVANIA: Bradford Hills, Chester Co., June 26, 1910, *Bartram 1007* (ANSP, G); vicinity of Millersville, Lancaster Co., July 10, 1890, *Small* (NY, P).

DELAWARE: Centerville, 1866, *Commons* (MBG); same locality, June 24, 1879, *Commons* (US, G); Ellendale, July 23, 1878, *Canby* (US).

MARYLAND: Berwyn, June 5, 1912, *Greene* (MBG, US, ND); Deer Park, Aug. 4, 1906, *Carter* (ANSP); Hancock, June 11, 1927, *Woodson 1730* (MBG).

VIRGINIA: Dam Neck, Princess Anne Co., low ground, meadow, June 27, 1922, *Randolph & Randolph 481* (G); near Ocean View, Norfolk Co., July 8, 1898, *Kearney 1472* (US); Suffolk, Nansemond Co., June 8-13, 1893, *Heller 970* (US); Lacey Springs, June 12, 1927, *Woodson 1655* (MBG); Dumfries, June 13, 1927, *Woodson 1679* (MBG); roadside near Charlottesville, June 22, 1927, *Woodson 1746* (MBG); Buckroe, sandy meadow near seashore, May 18, 1912, *Robinson 362* (G); Glen Carlyn, June 25, 1905, *House 1060* (NY); Norfolk, May 25, 1922, *Meredith* (ANSP); Great Falls, dry field, Sept. 9, 1909, *Bartlett 1768* (P, D).

NORTH CAROLINA: moist grounds, [near Biltmore?], July 12, 1897, *Biltmore Herb. 79b* (MBG, US, NY).

SOUTH CAROLINA: Anderson, suburbs, damp banks, Aug. 15, 1919, *Davis 4984* (MBG); Anderson, dry soil, Aug. 15, 1919, *Davis 8426* (MBG).

GEORGIA: along railway, McDuffie Co., vicinity of Thomson, Aug. 5, 1909, *Bartlett 1690* (P).

FLORIDA: Jefferson Co., June-July, 1898, *Hitchcock* (MBG).

MISSISSIPPI: Ackerman, June, 1905, *Jensen 7* (MBG); Dlo, edge of pine forest, April 19, 1927, *Woodson & Anderson 1551* (MBG).

LOUISIANA: exact locality and date lacking, *Hale* (MBG).

OHIO: New Westerville, roadsides, June 10, 1927, *Woodson 1701* (MBG); Pittsfield, Lorain Co., date lacking, *Ricksecker* (US).

WEST VIRGINIA: near Wheeling, June 10, 1927, *Woodson 1676* (MBG); field, six miles north of Martinsburg, June 12, 1927, *Woodson 1682* (MBG); Harper's Ferry, banks of the Shenandoah, Oct. 21, 1913, *Greene* (ND).

MICHIGAN: edge of swampy ground on Belle Isle, July 16, 1892, *Farwell* (US); Flint, date lacking, *Canby 3422* (US).

INDIANA: Wells Co., Harrison Tp., on dry hills along Erie right-of-way, June 30, 1905, *Deam 11* (MBG, US); Steckland, 1889, *Evermann* (US); roadside along woods on the east side of Pitcher's Pond, about 5 mi. southwest of Mt. Vernon, Posey Co., June 14, 1918, *Deam 25405* (D); in woods, north boundary, State

Reservation, Clark Co., June 30, 1910, *Deam* 6901 (D); bank of the White River, near Blue Bluffs, Morgan Co., July 13, 1907, *Deam* 2276 (D); roadside bank 1 mi. east of Willow Valley, Martin Co., July 13, 1915, *Deam* 17217 (D); in alluvial soil in the open woods in Jackson Park, about 1½ mi. west of Centerville, Wayne Co., July 3, 1913, *Deam* 13562 (D); in a deep black and white oak woods 4 mi. southeast of Corydon, Harrison Co., June 27, 1916, *Deam* 20524 (D).

KENTUCKY: Lexington, date lacking, *Griswold* 1 (US).

ILLINOIS: Carbonate, 1878, *French* (US); dry prairie, Wabash Co., July 2, 1902, *Schenck* (US).

MINNESOTA: roadside, near Forest Lake, June 28, 1928, *Anderson & Woodson* 5040 (MBG).

IOWA: exact locality lacking, Aug. 9, 1872, *Arthur* (MBG, US).

MISSOURI: Allenton, June 30, 1912, *Letterman* (MBG); Jerome, June 6, 1914, *Kellogg* 470 (MBG); Jefferson Barracks, St. Louis Co., June 17, 1890, *Hitchcock* (MBG); rocky ledges, high hills, Galena, Stone Co., May 28, 1914, *E. J. Palmer* 5792 (MBG); near summit, Pilot Knob, Iron Co., May 21, 1927, *Woodson* 2703 (MBG); barrens, Wild Horse Creek Valley, St. Louis Co., June 16, 1918, *Hoffmann* (MBG).

TEXAS: in groups, margins of water-courses, Pierdenales and Three Creeks, June, 1847, *Lindheimer* 659 (MBG); rocky creek-beds, Lindendale, Kendall Co., May 26, 1916, *E. J. Palmer* 9893 (MBG); Purdy Creek, Gillespie Co., date lacking, *Jermy* 196 (MBG).

NEW MEXICO: High Rolls, Otero Co., May 31, 1902, *Viereck* (ANSP).

6a. *Apocynum cannabinum* L. var. *pubescens* (Mitchell) A. DC. in DC. Prodr. 8: 440. 1844; Bég. & Bel. R. Accad. Lincei, V. 9: 103. 1913.

Apocynum cannabinum Michx. Fl. Bor.-Am. 1: 121. 1803, *non* L.

Apocynum pubescens Mitchell ex R. Br. Mem. Wern. Soc. 1: 63. 1809.

"*Apocynum pubescens* R. Br." ex Ell. Sketch Bot. S. C. & Ga. 1: 315. 1821; Torr. Fl. N. & Mid. States, 276. 1824; G. Don,

Hist. Dichlam. Pl. 4: 81. 1838; Darby, Bot. South. States, ed. 2. 434. 1860; Britt. & Brown, Ill. Fl. 3: 23. 1913; Millsp. Fl. W. Va. 331. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. 21: 230. 1919.

"*Apocynum cannabinum* L. var. *pubescens* (R. Br.) DC." ex A. Gray, Man. Bot. ed. 1, 364. 1848; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 662. 1908; Stone, Pl. South. N. J. 646. 1911; Wiegand & Eames, Fl. Cayuga, etc. 646. 1926.

Apocynum palustre Greene, Leafl. Bot. Obs. & Crit. 1: 58. 1904.

Apocynum Bebbianum Greene, l. c. 2: 168. 1912.

Apocynum dictyotum Greene, l. c. 169. 1912.

Apocynum cinereum Nieuwl. Am. Midl. Nat. 3: 56. 1913.

Apocynum tomentellum Nieuwl. l. c. 55. 1913, *non* Greene.

Apocynum tomentulosum Nieuwl. l. c. 166. 1913.

Apocynum cannabinum L. var. *pubescens* (R. Br.) A. DC. forma *pennsylvanicum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 103. 1913, *nomen*.

Apocynum cannabinum L. var. *palustre* (Greene) Bég. & Bel. l. c. 1913.

Stems tomentulose or glabrate; leaves tomentulose or pubescent upon either surface; inflorescence tomentose; in all other essential characters similar to the species.

Distribution: generally throughout the southeastern and central United States, also in north-central California; a frequent ballast weed. One collection has also been made in extreme southern Ontario.

Specimens examined:

CANADA:

ONTARIO: Leamington, July 20, 1906, Fisher (D).

UNITED STATES:

MASSACHUSETTS: Centreville, sandy copse, Scudder's Bay, July 5, 1896, Williams (G).

RHODE ISLAND: Block Island, dry roadside banks and thickets, northeast of Great Salt Pond, Aug. 20, 1913, Fernald, Hunnewell & Long 10241 (NE).

CONNECTICUT: Southington, July 15, 1902, Bissell (NE); East Lyme, New London Co., June 26, 1903, Graves (NE); Fairfield, Sept. 26, 1895, Eames (NE); Southington, July 17, 1903, Andrews (ND).

NEW YORK: "western New York," exact locality and date lacking, *Torrey* (G, NY); moist field near Larch Meadows, Ithaca, Aug. 23, 1916, *Munz* 601 (P); Junius, marly moor of Lowery's Pond, Aug. 4, 1919, *Eames & Wiegand* 12761 (G); Ithaca, gravelly roadside, June 28, 1919, *Wiegand* 12760 (G).

NEW JERSEY: along railroad, Lakewood, Ocean Co., May 30, 1908, *Mackenzie* 3093 (MBG, US); Mine Brook, July, 1891, *Perry* (MBG); Glassboro, July 4, 1865, *Redfield* 4871 (MBG).

PENNSYLVANIA: McCall's Ferry, July 2-6, 1904, *Britton* (NY); Brownsville, June 10, 1927, *Woodson* 1656 (MBG); open places in the forest at Penryn, in old red sandstone, Aug. 7, 1926, *Heller* 14239 (MBG).

DELAWARE: Wilmington, in woods, July 1, 1923, *Tidestrom* 11516 (G, US); dry field near Georgetown, Sussex Co., July 5-6, 1908, *Britton* 48 (NY, MBG).

MARYLAND: Silver Spring, Montgomery Co., June 28, 1899, *Miller* (US, P); Ocean City, July 12, 1909, *Carter* (NY); Kensington, June 11, 1905, *House* 1007 (NY).

DISTRICT OF COLUMBIA: B. & O. railroad embankment, July 17, 1893, *Boettcher* 141 (G, MBG, US, NY); Woodridge, July, 1913, *Greene* (MBG, US).

VIRGINIA: Suffolk, June, 1893, *Heller* 464 (US); Chain Bridge, Fairfax Co., July 12, 1899, *W. Palmer* 7 (G); Falls Church, July 30, 1874, *Carter* (ANSP); near Maurertown, June 12, 1927, *Woodson* 1672 (MBG); Arlington Junction, Aug. 3, 1912, *Greene* (MBG, US); ten miles north of Amelia in moist soil along the highway in a wooded area, July 9, 1926, *Heller* 13998 (MBG); exact locality lacking, 1865, *Glatfelter* (MBG).

NORTH CAROLINA: coastal plain at White Lake, in sand, July 16, 1926, Bladen Co., *Heller* 14103 (MBG); sand banks near Beaufort, 1906, *Lewis* 220 (NY); Mt. Airy, June 19, 1909, *Rusby* (NY).

SOUTH CAROLINA: paper mill, Hartsville, May 22, 1909, *Coker* (NY); Santee Canal, May, year lacking, *Ravenel* (G); Abbeville, July, 1855, *Hexamer & Maier* (G).

GEORGIA: edge of pine barren, vicinity of Thomson, McDuffie Co., July 26, 1909, *Bartlett* 1661 (P).

ALABAMA: Clanton, Apr. 21, 1927, *Woodson & Anderson* 1608

(MBG); Valley Head, July 18, 1898, *Ruth* 463 (NY); Auburn, Apr. 25, 1898, *Earle* 1644 (NY).

MISSISSIPPI: Ridgway, Apr. 18, 1927, *Woodson & Anderson* 1541 (MBG); Jackson, Apr. 18, 1927, *Woodson & Anderson* 1549 (MBG).

OHIO: exact locality and date lacking, *Throop Herb.* (P); Rocky River, near Cleveland, July 8, 1896, *Greenman* 1438 (MBG); near Cincinnati, June 20, 1888, *Lloyd* 296 (MBG).

INDIANA: Bluffton, Sept. 1, 1904, *Deam & Gleason* (G); Notre Dame, along railroad, Oct. 8, 1913, *Nieuwland* 11603 (MBG); Notre Dame, near ice house, June 23, 1913, *Nieuwland* 11316 (MBG); in wooded lot across railway from Notre Dame University, June 29, 1928, *Nieuwland, Slavin & Woodson* 3 (MBG); on rocky exposed hillside between Madison and North Madison, Jefferson Co., May 28, 1911, *Deam* 8489 (D); in dry channel of creek near Langdon, Jackson Co., June 30, 1913, *Deam* 13517 (D); along east side of Winona Lake, Kosciusko Co., July 28, 1904, *Deam* (D); on the bank of the Ohio River at Vevay, Switzerland Co., July 25, 1913, *Deam* 13806 (D); low place near a wagon road in woods on the "knobs," 9 mi. north of Rockport, Spencer Co., June 9, 1918, *Deam* 25230 (D); roadside about 5 mi. west of Danville, Hendricks Co., July 13, 1913, *Deam* 13673 (D); sandy prairie roadside 1 mi. southwest of Bee Hunter, Greene Co., July 3, 1918, *Deam* 25647 (D); dry open woods along Little Indian Creek, about 5 mi. northwest of New Albany, June 21, 1916, *Deam* 20346 (D).

KENTUCKY: along roadsides, Lexington, July 20, 1923, *McFarland* 131 (MBG); Iron Hill, Lyon Co., June 18, 1909, *Eggleston* 4805 (NY).

TENNESSEE: Knoxville, June, 1897, *Ruth* 3088 (NY); Obion Co., fields, in thin soil, June 28, 1893, *Bain* 160 (G); Franklin Co., woods near Anderson, June 7, 1897, *Eggert* (MBG); open banks, low ground, near Memphis, Shelby Co., May 18, 1920, *E. J. Palmer* 17528 (MBG).

WISCONSIN: Racine Co., July, 1882, *Hasse* (NY); Preble, Brown Co., July 31, 1886, *Schuette* (NY).

ILLINOIS: Winnebago Co., Fountaindale, date lacking, *Bebb* (ND, US); rock road near Fish Lake, July 16, 1898, *Norton*

(MBG); slough, near Columbia, Sept. 1, 1927, *Woodson* 1926 (MBG); East St. Louis, June 19, 1879, *Eggert* (MBG); prairie, near Wady Petra, June 19, 1900, *V. H. Chase* 631 (MBG, US); Odin, June 12, 1898, *Greene* (US).

MINNESOTA: cultivated fields north of Faribault, June 26, 1928, *Anderson & Woodson* 5013 (MBG).

IOWA: Polk Co., July, 1847, *C. L. Parry* (NY).

MISSOURI: Courtney, dry ground, Aug. 2, 1906, *Bush* 4083 (G, US, MBG); Swope Park, barrens, July 21, 1915, *Bush* 7053 (G, MBG, US, NY); Webb City, prairies, June 23, 1911, *E. J. Palmer* 3426 (G, MBG); Mansfield, frequent, open woods, etc., alt. 1480 ft., June 5-12, 1911, *Lansing* 3171 (G, F); Sibley, dry ground, June 27, 1909, *Bush* 5849 (G, MBG, NY); Courtney, common everywhere, July 17, 1899, *Bush* 314 (G, MBG, NY, US); Jackson Co., July 16, 1893, *Bush* 243 (G, MBG); Allenton, July 30, 1901, *Letterman* (MBG); near Cliff Cave, St. Louis Co., July 29, 1886, *Eggert* (MBG); Moscow Mills, July 23, 1927, *Woodson* 1719 (MBG); Forest Mill, Jasper Co., June 23, 1909, *E. J. Palmer* 2336 (MBG); near Webster Groves, railroad embankment, July 25, 1927, *Woodson* 1729 (MBG); along Mo. Pac. Ry. 1. mi. s. of station, Webb City, June 23, 1911, *E. J. Palmer* 3426 (MBG); dry open slope beside Ely Street, Hannibal, Marion Co., Aug. 21, 1914, *Davis* 2947 (MBG); south of Oakwood, Ralls Co., July 16, 1915, *Davis* 4762 (MBG); Turkey Creek, Jasper Co., July 10, 1897, *Trelease* 709 (MBG); Shut-In, Arcadia, Iron Co., May 8, 1925, *Woodson* 384 (MBG); Jefferson Barracks, St. Louis Co., June 17, 1890, *Hitchcock* (MBG); upland prairies near Asbury, Jasper Co., June 23, 1928, *E. J. Palmer* 34676 (MBG).

ARKANSAS: low open ground, Corning, Clay Co., June 25, 1914, *E. J. Palmer* 6092 (MBG).

NORTH DAKOTA: Valley City, Aug. 6, 1917, *Mabbott* 257 (NY).

KANSAS: Riley Co., open ground, 1895, *Norton* 324 (G, US, NY, MBG).

OKLAHOMA: Copan, Washington Co., in thickety field, Aug. 15, 1913, *Stevens* 2105 (G); Sapulpa, common, July 30, 1894, *Bush* 363 (MBG).

TEXAS: Farragut Co., June 2, 1913, *Ruth* 387 (NY).

CALIFORNIA: Little Chico, June 1897, *Bruce 2093* (P); sloughs, Butte Co., May, 1898, *Bruce* (P); colonies in the marshes on drier spots, Suisun, Solano Co., June 6, 1903, *Baker 3247* (US, ND, MBG, P, G, NY).

Apocynum cannabinum L. var. *pubescens* is probably the most variable variety of the genus, and several foliage variations might be considered worthy of description in the absence of intergradations. Especially noteworthy in this instance is a race of obovate-leaved plants common in southern Missouri.

6b. *Apocynum cannabinum* L. var. *glaberrimum* A. DC. in DC. Prodr. 8: 439. 1844; Rydb. Mem. N. Y. Bot. Gard. 1: 311. 1900.

Apocynum canadense Shecut, Fl. Carol. 1: 187. 1806.

Apocynum piscatorium Dougl. ex A. DC. l. c. 1844, *nomen in synon.*

Apocynum album Greene, Pittonia 3: 230. 1897; G. S. Miller, Proc. Biol. Soc. Wash. 13: 88. 1899; Millsp. Fl. W. Va. 331. 1913.

Apocynum nemorale G. S. Miller, Proc. Biol. Soc. Wash. 13: 87. 1899; Bég. & Bel. R. Accad. Lincei, V. 9: 110. 1913.

Apocynum cannabinum L. var. *nemorale* (G. S. Miller) Fernald, Rhodora 10: 55. 1908.

Apocynum missouriense Greene, Leafl. Bot. Obs. & Crit. 2: 165. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 109. 1913.

Apocynum isophyllum Greene, l. c. 166. 1912.

Apocynum littorale Greene, l. c. 171. 1912.

Apocynum arenarium Greene, l. c. 173. 1912; Bég. & Bel. l. c. 109. 1913.

Apocynum Bolandri Greene, l. c. 175. 1912.

Apocynum Carolini Nieuwl. Am. Midl. Nat. 3: 53. 1913.

Apocynum pseudolaurinum Bég. & Bel. var. *latifolium* Bég. & Bel. l. c. 100. 1913, *nomen in synon.*

Apocynum cannabinum L. var. *album* (Greene) Bég. & Bel. l. c. 107. 1913.

Apocynum cannabinum L. var. *isophyllum* (Greene) Bég. & Bel. l. c. 1913.

Apocynum cannabinum L. var. *Bolandri* (Greene) Bég. & Bel. l. c. 108. 1913.

Apocynum cannabinum L. var. *floribundum* Bég. & Bel. l. c. 1913.

Apocynum nemorale G. S. Miller var. *glabrum* Bég. & Bel. l. c. 109. 1913.

Entire plant glabrous throughout; in all other essential characters similar to the species.

Distribution: probably common in every state in the United States, and sparingly in Canada; a common roadside and field weed.

Specimens examined:

CANADA:

QUEBEC: St. Lambert, près du pont Victoria, vicinité de Longueuil, Sept., 1919, *Victorin* 9653 (G).

ONTARIO: Point Abino, Welland Co., Aug. 23, 1886, *Coville* (US).

ALBERTA: Calgary, July 16, 1913, *Moodie* 116 (NY).

UNITED STATES:

NEW HAMPSHIRE: Alstead, by Cold River, Aug. 2, 1900, *Fernald* 375 (G).

VERMONT: Salisbury, among thickets on the shore of Lake Dunmore, July 14, 1908, *Williams* (NE); wet banks, Queechee Gulf, July 4, 1910, *Britton* (NY); Leicester, damp ground, July 26, 1924, *Dutton* (MBG, G).

MASSACHUSETTS: Sharon, June, 1905, *Poole* 36 (G); Huntington, rocky banks of small run, alt. 350 m., Aug. 17, 1912, *Robinson* 563 (G); along brook in meadow, Granville, June 25, 1914, *Seymour* 200 (MBG); stony shore, Stockbridge Brook, Berkshire Co., July 31, 1917, *Hoffman* (MBG).

CONNECTICUT: Wethersfield, *Gray* (G).

NEW YORK: Ithaca, Triphammer Falls, gravelly shore, Fall Creek, July 17, 1913, *E. J. Palmer* 965 (G); Savannah, Wayne Co., Crusoe Prairie, July 10, 1918, *Wright & Griscom* 10620 (G); bed of Chenango River, June 25, 1882, *Lucy* 5389 (MBG); marsh, Ithaca, July, 1878, *Trelease* (MBG); Fall Creek, June 26, 1889, *Norris* (MBG); Cayuga Flats, near Ithaca, July 15, 1893, *Schrenk* (MBG); East Greenwich, Long Island, 1867, *Fitch* (US); Chenango Forks, July, 1897, *Maxon* (US).

NEW JERSEY: open woods, Cranberry Lake, Sussex Co., June 24, 1906, *Mackenzie* 2125 (MBG, NY, D).

PENNSYLVANIA: Inglesnook, Dauphin Co., July 16, 1912, *Williamson* (ANSP); rocks above Zimmerman's Ferry, Monroe Co., June 23, 1918, *Bartram* (G, ANSP); Susquehanna, July, 1889, *Eby* (MBG); Conewango Mts., Sept. 7, 1898, *Eisenhower* (MBG); gravel, Easton, July 13–Nov. 28, 1895, *Porter* (US).

MARYLAND: Great Falls, open ground along north side of canal, June 21, 1917, *Hitchcock* 12909 (G, US); on sand-bar, Plum Point, Aug. 5, 1902, *Shull* 173 (US, G, MBG, NY); on bar north of Swan Creek, July 26, 1902, *Shull* 109 (MBG, US).

DISTRICT OF COLUMBIA: at Chain Bridge, original station [of *A. album*], by canal, June 23, 1912, *Greene* (US, MBG, NY); exact locality and date lacking, *Canby* (US); flats near Chain Bridge, June 20, 1899, *Lyon* (US, P).

VIRGINIA: Quinimond, Aug. 25, 1899, *Pollard & Maxon* (US); Blue Ridge Mts. east of Waynesville, June 12, 1927, *Woodson* 1698 (MBG).

GEORGIA: Wrightsboro, date lacking, *Chapman* (MBG); pine barrens, 1907, *Bartlett* 1124 (P); sandy field, MacDuffie Co., Sept. 18, 1908, *Bartlett* 1464 (P).

FLORIDA: Mary Esther, Apr. 28, 1908, *Tracy* 9449 (MBG, G, NY); old fields, Lake City, July 14, 1893, *Quaintance* (MBG); Aspalaga, 1898, *Chapman* (MBG); Apalachicola, date lacking, *Chapman* (NY).

ALABAMA: Jackson, Apr. 20, 1927, *Woodson & Anderson* 1548 (MBG); along A. G. S. Railroad, Valley Head, July 18, 1898, *Ruth* 481 (MBG, NY).

LOUISIANA: exact locality and date lacking, *Hale* (NY, G); borders of fields, near St. Martinsville, June 26, 1893, *Langlois* (ND).

OHIO: Garrettsville, July 25, 1901, *Webb* (G); Harmony, June 9, 1927, *Woodson* 1650 (MBG).

WEST VIRGINIA: pebbly shore of the Blackwater River, Hendricks, Tucker Co., Sept. 10, 1904, *Moore* 2097 (G); Berea, dry soil, waste field, Aug. 21, 1922, *Randolph & Randolph* 1356 (G).

INDIANA: on border of swamp, Blackford Co., June 25, 1905, *Deam* (US); Roby, bog, Sept. 1, 1907, *Lansing* 2679 (G, F); Spencer, moist sandy roadside, July 18, 1915, *Deam* 17555 (G, MBG, D); wooded bank of Claypole Pond, Knox Co., July 8,

1915, *Deam 17004* (D); on the east bank of the north fork of the Muscatatuck River, about 1 mi. north of Vernon, growing in rather open and rocky woods, July 9, 1911, *Deam 9135* (D); on a rocky ripple in Laugherty Creek back of Versailles, July 23, 1919, *Deam 13766* (D); on a stony bar of White Water River $\frac{3}{4}$ mi. northwest of Metamora. This bar overflows much of the wet season and plants are mostly decumbent, Sept. 12, 1924, *Deam 41020* (D); Dubois Co., on the border of the artificial lake about 1 mi. north of Jasper, July 2, 1912, *Deam 11566* (D).

KENTUCKY: Lexington, June, 1836, *Peter* (NY); North Bend, date lacking, *Short* (NY); Southern Hills, three miles south of Louisville, Aug. 15, 1892, *Bergmann* (MBG); Bowling Green, June 19, 1897, *Price* (MBG).

TENNESSEE: Robertson Co., woods near Greenbrier, July 13, 1897, *Eggert* (MBG).

WISCONSIN: near Portage, June 22, 1927, *Woodson 1660* (MBG); Milwaukee, Aug. 3, 1884, *Hasse* (NY).

ILLINOIS: St. Clair Co., French Village, Sept. 6, 1892, *Eggert* (MBG); Illinois State Park, Starved Rock, LaSalle Co., June-Sept., 1921, *Thone 33* (MBG); Olney, Richland Co., July 17, 1927, *Ridgway 2832* (MBG); near Falling Springs, St. Clair Co., Sept. 30, 1928, *Greenman 4594* (MBG); near 119th Street, West Pullman, Chicago, Aug. 8, 1907, *Greenman 1869* (MBG, F).

MINNESOTA: Hennepen Co., Aug. 1889, *Sandberg* (ND).

IOWA: fields and wastes, Decatur Co., Aug. 22, 1904, *J. P. Anderson* (MBG); exact locality lacking, July 20, 1875, *Arthur 23* (MBG).

MISSOURI: Webb City, rocky woods, Aug. 6, 1920, *Bush 9054* (NY, US, MBG); Carterville, July 13, 1920, *E. J. Palmer 18311* (NY, MBG); Cedar Gap, hillsides, alt. 1675 ft., May 22-June 2, 1911, *Lansing 2992* (G, F); Jackson Co., Aug. 8, 1883, *Bush* (MBG); Reeds, Jasper Co., June 28, 1913, *E. J. Palmer 4006* (MBG); St. Louis, July 3, 1895, *Glatfelter 338* (MBG); Creve Coeur Lake, July 4, 1906, *Johnson* (MBG); Silex, June 24, 1912, *Davis 1326* (MBG); St. Louis Co., in open woods, rather damp places, June, 1833, *Engelmann* (MBG); Joplin, July 4, 1902, common in woods, *E. J. Palmer 208* (MBG); Sarcoxie, rocky woods, Sept. 18, 1910, *E. J. Palmer 3188* (MBG); Mine La Motte,

Madison Co., June 22, 1897, *Monell* (MBG); Sheffield, common in fields, July 10, 1899, *Bush* 159 (MBG); bottoms, Cass Co., June 14, 1865, *Broadhead* (MBG); common in open grounds, Clay Co., Randolph, July 17, 1898, *Mackenzie* 253 (MBG); Allenton, June 8, 1896, *Kellogg* (MBG); near Gilmore, July 18, 1927, *Woodson* 1747 (MBG); Frisco R. R. embankment, Webster Groves, July 22, 1927, *Woodson* 1745 (MBG); Cliff Cave, St. Louis Co., May 9, 1879, *Eggert* (MBG); uncultivated field, near New London, Aug. 24, 1927, *Woodson* 1748 (MBG); roadside south of Festus, May 31, 1926, *Woodson* 681 (MBG).

ARKANSAS: Benton Co., date lacking, *Plank* (MBG); Benton, Saline Co., dry open ground, June 24, 1915, *E. J. Palmer* 8133 (MBG).

NORTH DAKOTA: Leeds, Aug. 21, 1907, *Lunell* (NY).

NEBRASKA: canyons, prairie & ruderal, Mitchell Co., Aug., 1899, *Hedgcock* (MBG); Republican Valley, alt. 2000 ft., May 21, 1894, *Laybourne* 86 (MBG); Republican River, June 27, 1856, Lieut. Bryant's Expedition, *H. Engelmann* (MBG); Belmont, July 25, 1889, *Webber* (MBG); Wahoo, June, 1890, *Rydberg* (NY).

KANSAS: Riley Co., wet places, Sept. 14, 1895, *Norton* 324 (G, MBG, NY).

OKLAHOMA: vicinity of Fort Sill, June 17, 1916, *Clemens* 11728 (MBG); Sapulpa, July 22, 1894, *Bush* 359 (MBG); low grassy place, near Cleo, Major Co., June 8, 1913, *Stevens* 798 (G, MBG).

TEXAS: moist river banks, Mertzon, Irion Co., July 4, 1917, *E. J. Palmer* 12420 (MBG); Sherman, wet banks, June 23, 1872, *E. Hall* 514 (G); locality lacking, 1835, *Drummond* 232 (G); Fredericksburg, June, 1847, *Lindheimer* 658 (G, MBG); Camp 36, Canadian, near sandhills, June, 1853, *Bigelow* 691 (G); San Marcos, 1897, *Stanfield* (NY); Dallas, low rich lands, 1874, *Reverchon* 599 (MBG); Coombs Ranch, Aug. 24, date lacking, *Reverchon* (MBG).

MONTANA: Box Elder Creek, Valley Co., July 14, 1900, *Blankinship* (MBG).

WYOMING: Hot Springs Bar, 20 mi. south of Jackson, July 19 1901, *Merrill & Wilcox* 1042 (G).

COLORADO: Montrose, July 17, 1897, *Shear* 4808 (NY); Canyon City, 1872, *T. S. Brandegee* 472 (MBG); Evans, 1909, *E. L. John-*

son 295 (MBG); Clear Creek Canyon, alt. 7000 ft., July 18, 1896, *Crandall* (MBG).

NEW MEXICO: Pecos, San Miguel Co., alt. 6700 ft., Aug. 18, 1908, *Standley 5044* (G, US); exact locality lacking, 1847, *Fendler 692* (MBG).

IDAHO: Priest Lake, Aug. 1901, *Piper 3702* (US, Epling Herb.); Clarke's Fork Valley, below Parma Mt., alt. 680 m., Aug. 21, 1895, *Leiberg 1557* (G, US, MBG); Twin Falls and Shoshone Falls, steep moist slope, alt. 3700 ft., July 26, 1911, *A. Nelson & Macbride 1361* (G, MBG, NY, F, W); open plains, Boise, alt. 2880 ft., July 13, 1911, *Clark 113* (G, MBG, NY, F).

UTAH: Peterson Canyon, alt. 8000-10000 ft., July 19, 1902, *Pammel & Blackwood 4009* (G); Little Falls, July-Oct. 1879, *Ward* (US); St. George, alt. 2700 ft., Sept. 29, 1894, *M. E. Jones 6099* (US, MBG, P); Provo, gravel, alt. 4500 ft., June 25, 1894, *M. E. Jones 5490* (MBG, P).

NEVADA: St. Thomas, May 25, 1919, *Tidestrom 9157* (US).

ARIZONA: White Mountains, Aug. 5-15, 1903, *Griffiths 5397* (US, MBG); Huachuca Mts., alt. 6000 ft., Sept. 3, 1903, *M. E. Jones* (P); Fort Whipple, river bottoms, Rio Verde, Sept. 9, 1865, *Coues & E. Palmer* (MBG); same locality, May, 1865, *Coues & E. Palmer 332* (MBG).

WASHINGTON: Lake Chelan, July 1, 1915, *Kammerer 71* (NY, MBG); meadows of the Okanogen River, Ophir, Okanogen Co., July, 1897, *Elmer 507* (MBG, W, US); foot of Priest Rapids, Yakima Co., July 17, 1903, *Cotton 1399* (MBG, W).

OREGON: dry sandy banks of Columbia River, Hood River Co., 1924, *Henderson 649* (MBG).

CALIFORNIA: Santa Rosa, Sonoma Co., June 22, 1902, *Heller 5732* (G, NY, ANSP, MBG, F, D); along stream, Vallecillo Canyon, Laguna Mts., San Diego Co., alt. 3800 ft., June 26, 1924, *Munz 8417* (P); borders of swamps, alt. 300 m., San Bernardino Valley, June 21, 1907, *Parish 11427* (P); along the sycamore slough, Stinchfield Ranch, July 8, 1916, Colusa Co., *Stinchfield 373* (P); Cuyamosa Lake, June 26, 1903, San Diego Co., *Abrams 3913* (MBG); Hot Springs, July 24, 1875, *E. Palmer 220* (MBG).

6c. *Apocynum cannabinum* L. var. *Greeneanum* (Bég. & Bel.) Woodson, n. comb. Plate 17.

Apocynum Greeneanum Bég. & Bel. Atti R. Accad. Lincei, V. 9: 111. 1913.

Calyx-lobes equaling or slightly surpassing the corolla; corolla 3-4 mm. long; leaves glabrous above, pubescent beneath; in all other essential characters similar to the species.

Distribution: known only from the type locality in West Virginia.

Specimens examined:

WEST VIRGINIA: Upshur Co., July 8, 1897, *Pollock* (MBG, US).

7. *Apocynum hypericifolium* Ait. Hort. Kew. ed. 1, 1: 304. 1789; Pursh, Fl. Am. Sept. 1: 179. ed. 1. 1814; Torr. Fl. N. & Mid. States, 276. 1824; G. Don, Hist. Dichlam. Pl. 4: 81. 1838; Hook. Fl. Bor.-Am. 1: 51. 1840; A. DC. in DC. Prodr. 8: 440. 1844; Wood, Classb. Bot. ed. 29, 457. 1853; Rydb. Fl. Colo. 269. 1906; Brown, Univ. Mo. Studies 2: 193. 1911; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 112. 1913; Bergman, Fl. N. D. 229. 1918; Tidestrom, Contr. U. S. Nat. Herb. 25: 419. 1925; Garrett, Spring Fl. Wasatch Region, 120. 1927. Plate 18.

Apocynum sibiricum Jacq. Hort. Vindob. 3: 37. 1770; Britt. & Brown, Ill. Fl. 3: 22. 1913; Hitchc. & Standl. Contr. U. S. Nat. Herb. 21: 230. 1919; Rydb. Fl. Rocky Mts. 669. 1917.

Apocynum purpureum Tausch, Flora 19: 385. 1836.

Apocynum cannabinum L. var. *hypericifolium* (Ait.) A. Gray, Man. Bot. ed. 1, 365. 1848; Robinson & Fernald in A. Gray, New Man. Bot. ed. 7, 663. 1908; Wiegand & Eames, Fl. Cayuga, etc. 344. 1926.

Apocynum hypericifolium Ait. form. *arenarium* Gates, Torreya 11: 128. 1911.

Apocynum estillinum Greene, Leafl. Bot. Obs. & Crit. 2: 165. 1912.

Apocynum procerum Greene, l. c. 169. 1912; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 111. 1913.

Apocynum ithacense Greene, l. c. 170. 1912; Bég. & Bel. l. c. 110. 1913.

Apocynum subuligerum Greene, l. c. 171. 1912.

Apocynum cannabinum L. var. *estillinum* (Greene) Bég. & Bel. l. c. 107. 1913.

Apocynum neogeum Bég. & Bel. l. c. 108. 1913.

Apocynum hypericifolium Ait. var. *typicum* Bég. & Bel. *l. c.* 113. 1913.

Apocynum hypericifolium Ait. var. *intermedium* Bég. & Bel. *l. c.* 1913, *non* Bég. & Bel. *l. c.* 92. 1913, *nomen in synon.*

Apocynum lividum Greene var. *texanum* Bég. & Bel. *l. c.* 127. 1913.

Apocynum Farwellii Greene var. *glaucum* Farwell, Rept. Mich. Acad. Sci. 17: 170. 1916.

Apocynum Farwellii Greene var. *glaucum* Farwell form. *ternarium* Farwell, *l. c.* 1916.

Apocynum Farwellii Greene var. *glaucum* Farwell form. *anomalum* Farwell, *l. c.* 1916.

Cynopaema hypericifolium (Ait.) Lunell, Am. Midl. Nat. 4: 509. 1916.

Stems erect or somewhat ascending, 2-5 dm. tall, glabrous throughout, freely branched; branches opposite to sub-opposite, ascending; leaves opposite, nearly, or quite, sessile, and frequently subamplexicaul, especially below, mostly cordate or obtuse at the base, glabrous, or glaucous beneath, ovate to lanceolate, usually obtuse or rounded at the apex, or rarely subacute, membranaceous, entire, mucronate, or rarely without a mucro; inflorescence terminal, the bracts conspicuous, semifoliaceous; corolla sphaerico-cylindrical, about as long as broad, 2-3.5 mm. long, 2-3 mm. broad, the lobes erect; calyx-lobes lanceolate to ovate-oblong, 1.5-2 mm. long, entire, glabrous, scarious, follicles relatively short and straight, 4-10 cm. long, widely divergent, the seed 3.5-4 mm. long, the coma of the seed 8-12 mm. long.

Distribution: common in northeastern temperate North America, westward to Texas and the Dakotas, infrequent to the Pacific Coast, where it passes into var. *salignum*.

Specimens examined:

NEWFOUNDLAND: Grand Falls, ledges and talus, north bank of Exploits River, below the Falls, July 22, 1911, *Fernald & Wiegand* 6092 (G); Port à Port, gravelly banks of Romaine, July 30, 1921, *Mackenzie & Griscom* 10413 (G).

CANADA:

NOVA SCOTIA: Sunny Brae, bar in river, July 29, 1913, *St. John* 1439 (G); valley of the Barrasois River, Cape Breton Island,

July 25, 1914, *Nichols* 345 (G); Five-mile River, Mant's Cove, July 19, 1920, *Pease & Long* 22317 (G); Springville, Pictou Co., Aug. 25, 1906, *C. B. Robinson* 502 (NY); between Windsor and Wolfville, June 26, 1863, *Howe* (NS); Pictou, Aug. 1873, *Lindsay* (NS).

NEW BRUNSWICK: Ingelside, Westfield, Aug. 8, 1909, sandy riverbank, *Fernald* 2074 (G); Woodstock, July 14, 1916, *Fernald & Long* 14404 (G, ANSP); Keswick Ridge, Bass River, July 16, 1880, *Fowler* (MBG).

QUEBEC: Philipsburg, sandy shore of Lake Champlain, Aug. 10-11, 1923, *Knowlton* (G); Hatley, Lake Massawippi, July 21, 1923, *Knowlton* (G); Saint André d'Argenteuil, July 28, 1925, *Adrien* 21986 (G); Hull, July 5, 1922, *Victorin* 15740 (G); Beaucheville, July 13, 1922, *Fernald & Pease* 25241 (G); vicinity of Montmorenci Falls, July 7, 1905, *Macoun* 68532 (G, US); Pointe Bleu, shores of St. John, July 23, 1921, *Victorin* 15742 (G); Matapedia, July 19, 1904, *Collins & Fernald* (G); Matane, Aug. 5, 1904, *Forbes* (G); Ste. Angele de Laval, July 31, 1923, *Chamberlain & Knowlton* (G); Compton, July 29, 1923, *Chamberlain & Knowlton* (G, US, MBG); sur les graviers calcaires de la Rivière Dartmouth, à 12 milles de l'embouchure, Gaspé, Juillet 27, 1923, *Victorin, Brunel, Rolland, Germain & Rousseau* 17337 (G, MBG, D); Matapedia, July 19, 1904, *Collins & Fernald* (G); Dumois, July 25, 1921, *Victorin* 15741 (G).

ONTARIO: vicinity of Ottawa, *Rolland* 142 (G); Ottawa, Lac des Chenes, Sept. 1914, *Rolland & Germain* (G); border of bog, near Ipperwash, June 17, 1927, *Woodson* 1686 (MBG); Grande Lake, Kingston Co., Oct. 17, 1879, *Fowler* (US).

MANITOBA: Lake Winnipeg Valley, 1857, *Bourgeau* (G).

SASKATCHEWAN: "south Saskatchewan," exact locality lacking, July 14, 1879, *Macoun* 171 (US); locality lacking, 1857-58, *Bourgeau* (US).

ALBERTA: Milk River, July 19, 1895, *Macoun* (US); Crane Lake, July 3, 1894, *Macoun* 5416 (G).

BRITISH COLUMBIA: Columbia Valley, 1860, *Lyall* (G); lower Frazer River, 1859, *Lyall* (G); Home Lake, Vancouver Island, July 27, 1887, *Macoun* (NY); Chilliwack Valley, Aug. 21, 1901, *Macoun* 54293 (US).

UNITED STATES:

MAINE: Rangeley Lakes, Middle Dam. Aug. 2, 1903, *B. L. Robinson* (G); East Livermore, sandy shore of Androscoggin River, June 23, 1908, *Parlin* 2386 (G); St. Francis, July 30, 1900, *Williams* (G); Alegash River, Aroostook Co., July 28, 1900, *Williams* (G); Twin Brooks, July 28, 1900, *Williams* (G); Bethel, July 23, 1906, *Williams* (G); Sidney, open river-shores, Aug. 18, 1916, *Fernald & Long* 14406 (G); Bar Island, St. Francis, July 14, 1903, *Pease* 2267 (NE); Fort Fairfield, Aug. 10, 1909, *Fernald* 2073 (G); Houlton, Aug. 12, 1909, *Fernald* 2076 (NE); Orono, July 12, 1897, *Fernald* (NE); Eddington, Sept. 16, 1897, *Fernald* (NE); Moosehead Lake, Sept. 1891, *Furbish* (NE); vicinity of Skowhegan, June 30, 1903, *Chamberlain* (NE); Strong, Franklin Co., 1894, *Furbish* (NE); Farmington, Aug. 13, 1894, *Fernald* (NE); Vassalboro, July 6, 1916, *Fernald & Long* 14402 (NE); Topsham, Sept. 1903, *Furbish* (NE); rocky river bottom, July 12, 1908, *Mackenzie* 3468 (MBG).

NEW HAMPSHIRE: Milford, river bed, June 21-Aug. 7, 1899, *Wheeler* (G); Shelburne, date lacking, *Faxon* (G); East Andover, border of lake, Aug. 15, 1903, *Day* (G); Plainsfield, July 24, 1890 *collector lacking* (G); north of Androscoggin River, near Gorham line, Shelburne, June 26, 1908, *Pease* 11332 (NE); Lake Ossipee, sandy beach, Aug. 10, 1921, *Pease* 18104 (NE); Lake Wentworth, June, 1903, *Fuller* (NE); Hillsborough, open ground, July 28, 1920, *Batchelder* (NE); Langdon, gravelly margin of Cold River, July 10, 1899, *Fernald* 37 (NE); Walpole, June 12, 1912, *Batchelder* (NE).

VERMONT: Brattleboro, river-bank, Aug. 2, 1898, *B. L. Robinson* 135 (G); Brookline, West River, Aug. 4, 1900, *Egglesston & Grout* 2060 (G); Peacham, date lacking, *Blanchard* (MBG); Gardiner's Island, Ferrisburg, July 17, 1909, *Egglesston* 4872 (MBG); Salisbury, Lake Dunmore, July 14, 1908, *Williams* (NE); Knight's Island, Lake Champlain, July 23, 1882, *Brainerd* (NE); Wallingford, Mill River, July 14, 1909, *Kent* (NE); Lake Champlain, July 2, 1902, *Fuller* (NE); Townshend, Aug. 12, 1915, *Wheeler* (NE).

MASSACHUSETTS: Granville, along brook in meadow, June 25, 1914, *Seymour* 200 (G, MBG); Willoughby Lake, July 3, 1854, *Boott* (G); Sharon, Lake Massapoag, Sept. 10, 1899, *Williams* (G); Lawrence, July 9, 1902, *Pease* 1089 (NE); Lynn, sluice pond,

July 5, 1880, *Young* (NE); Lancaster, near Sterling, July 6, 1913, *Forbes* (NE); South Deerfield, June 26, 1925, *Churchill* (NE); Springfield, July 13, 1914, *Andrews* (NE); Stockbridge, July 13, 1914, *Andrews* (NE); Cheshire, Sept. 5, 1915, *Knowlton* (NE).

RHODE ISLAND: Ouanochoutaug, Washington Co., July 24, 1920, *Hope* (NE).

CONNECTICUT: Lyme, alluvial soil, Aug. 29, 1901, *Bissell* (G); East Hartford, July 21, 1911, *Driggs* (NE); Windsor, June 6, 1903, *Driggs* 2326 (NE).

NEW YORK: Butler, Westburg Bog, July 3, 1919, *A. H. Wright* 12759 (G); Canton, Aug. 4, 1916, *Phelps* 1690 (G); Junius, moor of Newton's Pond, date lacking, *Wiegand* 3038 (G); Ithaca, Six-Mile Creek, Oct. 11, 1913, *Eames & McDaniels* 964 (G); Morris-town, shore of Black Lake, June 21, 1914, *Phelps* 783 (G); Oneida Lake, Vienna Beach, June 21, 1903, *Haberer* 2202 (G, NY); Oneida Co., Sylvan Beach, Aug. 24, 1906, *House* 2822 (G, NY); Norwich Creek, Aug. 7, 1888, *Fitch* (P); Oxford River, Chenango Co., June 28, 1884, *A. L. Coville* (P); near Syracuse, *Underwood* (US); Penn Yann, Yates Co., date lacking, *A. H. Wright* (US); Schroon Lake, Essex Co., Aug. 16, 1887, *Heller* (ANSP); Ithaca, June 27, 1885, *F. V. Coville* (US).

PENNSYLVANIA: Wrightsville, June 7, 1890, *Small* (NY); about the mouth of the Tucquan, Lancaster Co., Oct. 20, 1901, *Heller* (US); Frazer, Chester Co., dry shale bank, June 19, 1910, *Bartram* (G, ANSP); mouth of Tucquan, Lancaster Co., July 6, 1893, *Heller & Halbach* 1039 (G, MBG, US); open places in the forest at Penryn in old red sandstone, Lebanon Co., Aug. 7, 1926, *Heller* 14240, in part. (MBG).

NEW JERSEY: Sussex Co., June 9, 1918, *Bartram* (ANSP); Phillipsburg, Aug. 15, 1890, *Porter* (NY); Newton, Apr. 19, 1907, *Carter* (ANSP).

DELAWARE: New Castle, July 11, 1894, *Tatnall* (G); Seaford, Sept. 12, 1902, *Norton* (MBG).

DISTRICT OF COLUMBIA: hard sterile clay, near 15th & H Sts. Washington, Aug. 7, 1912, *Greene* (MBG, US).

OHIO: Berea, June, 1896, *Ashcroft* (G); Berlin, June, 1896, *Hicks* (MBG); Erie Co., on sand dunes on Cedar Point opposite Sandusky, July 12, 1903, *Deam* (D).

WEST VIRGINIA: White Sulphur, Aug. 12, 1922, *Randolph & Randolph* 1240 (G); Piedmont, Sept. 20, 1881, *Donnell-Smith* (G, US).

MICHIGAN: Hubbardstown, 1877, *E. F. Smith* (G).

INDIANA: Notre Dame, Oct. 3, 1912, *Nieuwland* 10379 (ND, MBG); Roby, damp thicket, July 12, 1906, *Lansing* 2543 (G, F, US); Miller's, July 7, 1908, *Lansing* 2769 (G); Crothersville, June 30, 1913, *Deam* 13500 (MBG, G); Jackson Co., along the railroad $\frac{1}{4}$ mi. south of Chestnut Ridge, June 7, 1913, *Deam* 13280 (D); Knox Co., bank of the Wabash River, 2 mi. northeast of Mt. Carmel, Illinois, growing in thin soil on the sandstone rock, September 21, 1920, *Deam* 32972 (D); in rock ballast along the traction line, 2 mi. north of Scottsburg, Scott Co., July 27, 1920, *Deam* 31973 (D); along railroad near Sandy Hook Switch, about $6\frac{1}{2}$ mi. southwest of Washington, Daviess Co., July 2, 1918, *Deam* 25609 (D); in the bottom of an old gravel pit along the Penna. Ry., about 3 mi. north of Columbus, Bartholomew Co., Sept. 15, 1912, *Deam* 12405 (D).

WISCONSIN: Milwaukee, date lacking, *Lapham* (G); Brown Co., July 9, 1881, *Schuette* (G, US); Preble, Brown Co., July 31, 1886, *Schuette* (US).

ILLINOIS: Champaign, June 27, 1899, *Gleason* 687 (G); Stony Island, Cook Co., Sept. 10, 1893, *H. H. Smith* 5935 (G); near East Carondelet, St. Clair Co., July 18, 1893, *Eggert* (MBG); Cahokia, July 31, 1890, *Hitchcock* (MBG).

MINNESOTA: Brainerd, Aug. 10, 1903, *Mell & Knopf* (MBG); *Clitherall* (US).

IOWA: exact locality lacking, 1886, *Norris* (MBG); exact locality lacking, July 15, 1875, *Arthur* (MBG).

MISSOURI: banks of the Mississippi, below St. Louis, Aug., 1863, *Engelmann* (MBG); Courtney, June 27, 1900, *Bush* 809 (MBG); open dry bank, Dodson, June 9, 1917, *Hoffman* (MBG).

NORTH DAKOTA: borders of Lake Ibsen, Sept. 3, 1899, *Lunell* (G, NY); Leeds, Aug. 2, 1899, *Lunell* (G, ND, NY); plains, exact locality and date lacking, *Hooker* (G); in low open area about lake, Fort Totten, July 2, 1912, *Bergman* 1932 (MBG).

SOUTH DAKOTA: White Rock, 1903, *Powell* (G); Deadwood, elev. 4500 ft., Aug. 26, 1910, *Murdock* 4330 (G); Brookings, 1903, *Johnson* (MBG).

NEBRASKA: Red Cloud, July 5, 1907, *Bates* (G); Norway, Middle Loup district, on hills, June 22, 1893, *Rydberg* 1353 (NY, G, US); Fort Kearney, July 1-13, 1849, *Gunison* (G); Cheyenne Co., alt. 3700 ft., Aug. 6, 1901, *H. P. Baker* (MBG); Oasis, sand-hills of western Nebraska, July 13, 1912, *Poole & Folsom* (MBG); Middle Gulch, Scotts Bluff Co., Aug. 13, year and collector lacking (MBG); roadsides, near western outskirts of McCook, Red Willow Co., July 11, 1929, *Woodson* 29162 (MBG); dry fields, west of Friend, Saline Co., June 14, 1929, *Woodson & Anderson* 28988 (MBG).

KANSAS: Osborne City, hills, June 5, 1894, *Shear* 88 (G); Garden City, June 17, 1891, *Menke* (MBG).

OKLAHOMA: Canadian River, Norman, Oct. 3, 1914, *Emig* 878 (MBG); Woodward Co., prairies near Woodward, June 6, 1901, *Eggert* (MBG).

TEXAS: Pierdenales, June, 1847, *Lindheimer* 659, in part (G, MBG); Estelline, sands, May 25, 1904, *Reverchon* 4309 (US, MBG, G, F, P); Post, Garza Co., May 31, 1918, *E. J. Palmer* 13849 (MBG); in watered canyons, Gamble's Ranch, Armstrong Co., June 5, 1918, *E. J. Palmer* 13926 (MBG); Turtle Creek, Kerr Co., May 2, 1899, *Bray* 216 (US); moist open ground along small creek, 15 miles south of Alpine, Brewster Co., May 28, 1928, *E. J. Palmer* 34233 (MBG).

WYOMING: C. Y. Ranch, July 23, 1894, *A. Nelson* 596 (MBG, NY, F, G).

Jacquin published *A. sibiricum* nineteen years previous to the publication of *A. hypericifolium* Ait. Moreover, the description of the former was accompanied by a full-page folio illustration of the habit of the plant. The Latin description of the former, also, was far more elucidating than the unillustrated and terse description of Aiton. However, as can be quickly perceived by a glance at the citations in literature on page 133, botanists were quick to take up *A. hypericifolium* Ait., while *A. sibiricum* Jacq., perhaps because of the misleading geographical adjective, was disregarded for over a hundred years after its publication. In such a case, the practical course is to follow the so-called "Fifty year rule" tacitly established in the International Code of Nomenclature, and adopt the better-known designation.

7a. *Apocynum hypericifolium* Ait. var. *Farwellii* (Greene) Woodson, n. comb.

Apocynum Farwellii Greene, Leafl. Bot. Obs. & Crit. 2: 168. 1912.

Apocynum Farwellii Greene form. *verticillare* Farwell, Rept. Mich. Acad. Sci. 17: 170. 1916.

Plant variously pubescent; in all other essential characters similar to the species.

Distribution: central New York, eastern Michigan, and northern Indiana; apparently also collected in Texas.

Specimens examined:

NEW YORK: thickets near Oneida Castle, Oneida Co., June 17, 1921, *House 8100* (G, NY).

MICHIGAN: Huron Co., Saginaw Bay, in wet places, Aug. 24, 1908, *Farwell* (US, G); Detroit, July 7, 1898, *Farwell* (US, ND).

INDIANA: Bluffton, margin of a peat-bog lake, Sept. 1, 1904, *Deam & Gleason* (G, NY); Steuben Co., on east shore of Clear Lake, September 11, 1904, *Deam* (D); Noble Co., in low place near Rome City, July 21, 1904, *Deam* (D); in wood about $\frac{1}{8}$ mi. south of Hartford, Blackford Co., July 8, 1906, *Deam 1168* (D).

TEXAS: exact locality lacking, 1847, *Lindheimer 659*, in part (MBG).

Upon one of his collecting trips in southern Ontario, the author happened upon a most peculiar plant growing near the margin of a bog at Ipperwash, on the shore of Lake Huron (Woodson 1686, Mo. Bot. Gard. Herb.). Several of the stems arising from the common rhizome bore ordinary opposite leaves, obtuse at the apex; while one stem alone bore leaves decidedly acute at the apex in clusters of three throughout the length of the stem. Such an anomaly might be assigned to a chimera or to the action of certain gall-producing flies or other insects, although no mark of them is evident upon the specimen. Such a phenomenon has also been observed by Mr. O. A. Farwell in the neighboring state of Michigan, and the plants have been designated as *A. Farwellii* Greene form. *verticillare* Farwell, *A. Farwellii* Greene var. *glaucum* Farwell form. *ternarium* Farwell, and *A. Farwellii* Greene var. *glaucum* Farwell form. *anomalum*. However, in the light of the author's personal experience with such vegetative freaks, all such

phenomena in the case of the genus *Apocynum* are judged unworthy of nomenclatural designation.

Because of its geographical distribution, as well as for the reason of vegetative variability, *A. hypericifolium* var. *Farwellii* is regarded as a probable spontaneous variation analogous to *A. medium* var. *sarniense*.

7b. *Apocynum hypericifolium* Ait. var. *cordigerum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 114. 1913.

Apocynum cordigerum Greene, Leafl. Bot. Obs. & Crit. 2: 164. 1911.

Leaves ovate to obovate, deeply cordate to amplexicaul, at least below; in all other essential characters similar to the species.

Distribution: upper Mississippi Valley, from the Dakotas, Minnesota, and Wisconsin, to Missouri and Illinois.

Specimens examined:

WISCONSIN: Hillside, near Mazomanie, June 22, 1927, Woodson 1740 (MBG); south of La Crosse, fields, June 25, 1928, Anderson & Woodson 5005 (MBG).

ILLINOIS: Red Bud, June 3, 1888, Pammel (MBG).

MINNESOTA: locality lacking, July, 1849, Sykes (MBG).

MISSOURI: four miles east of Blue Springs in an uncultivated field, July 3, 1926, Heller 13988 (MBG); Ethel, June 12, 1915, Bush 7611 (MBG).

NORTH DAKOTA: Grand Forks, prairies, July 20, 1895, Brannon (MBG); Butte, Benson Co., July 14, 1907, Lunell (D); in gravel on the beach, Devil's Lake, Ramsey Co., Aug. 18, 1910, Lunell (D).

SOUTH DAKOTA: Brookings, T. A. Williams (US).

NEBRASKA: bottoms of Platte River, July 9, year lacking, H. Engelmann (MBG).

7c. *Apocynum hypericifolium* Ait. var. *salignum* (Greene) Bég. & Bel. Atti R. Accad. Lincei, V. 9: 115. 1918. Plate 19.

Apocynum salignum Greene, Pittonia 5: 64. 1902.

Apocynum nevadense Good. Bot. Gaz. 37: 57. 1904.

Apocynum cervinum Greene, Leafl. Bot. Obs. & Crit. 2: 174. 1912.

Apocynum Breweri Greene, l. c. 176. 1912.
Apocynum densiflorum Greene, l. c. 1912.
Apocynum thermale Greene, l. c. 1912.
Apocynum longifolium Greene, l. c. 177. 1912.
Apocynum hypericifolium Ait. var. *latifolium* Bég. & Bel. l. c. 115. 1913, *nomen in synon.*
Apocynum cuspidatum Greene ex Bég. & Bel. l. c. 1913, *nomen in synon.*
Apocynum Macounii Greene ex Bég. & Bel. l. c. 1913, *nomen in synon.*
Apocynum hypericifolium Ait. var. *nevadense* (Good.) Bég. & Bel. l. c. 1913.
Apocynum hypericifolium Ait. var. *oblongum* (Greene) Bég. & Bel. l. c. 1913.
Apocynum pseudolaurinum Bég. & Bel. var. *dubium* Bég. & Bel. l. c. 1913, *nomen in synon.*

Corolla tubulo-cylindrical, longer than broad; coma of the seeds 15-20 mm. long; in all other essential characters similar to the species.

Distribution: Pacific Coast to the Rocky Mountains; infrequent eastward to central Minnesota and Texas.

Specimens examined:

CANADA:

MANITOBA: Brandon, July 24, 1896, *Macoun* 14156 (G).

SASKATCHEWAN: Saskatoon, July 27, 1906, *Macoun & Herriot* 78489 (G, US).

BRITISH COLUMBIA: Penicton, 1903, *Newcombe* 293 (F); near international boundary, between Kettle and Columbia Rivers, June 30, 1902, *Macoun* 66554 (US, ND).

UNITED STATES:

MINNESOTA: near Northbranch, Chisago Co., June 26, 1928, *Woodson & Anderson* 5025 (MBG).

SOUTH DAKOTA: Brookings, Aug. 1894, *Thornber* (MBG).

NEBRASKA: Nuckolls Co., prairies and canyons, July, 1899, *Hedcock* (MBG).

TEXAS: Limpia Canyon, Apr. 26, 1902, *Tracy & Earle* 286 (MBG, G, US).

MONTANA: Sixteen-Mile Creek, alt. 4500 ft., July 10, 1863,

Scribner 151 (G, ANSP, US); Yellow Bay, Flathead Lake, Aug. 11, 1908, *M. E. Jones* 8878 (P).

WYOMING: Platte River, near Ferris, July 19, 1898, *E. Nelson* 4901 (P); on Gardner River, among shrub-like plants, July 19, 1899, *Nelson & Nelson* 6923 (P).

COLORADO: Paradox, Monroe Co., creek bottoms, June 28, 1912, *Walker* 191 (G, MBG, NY, US); Naturita, river bottoms, alt. 5400 ft., June 24, 1913, *Payson* 116 (G, MBG); Deer Run, alt. 4700 ft., June 11, 1901, *Baker* 80 (G, ND, US, P, MBG, W); damp ground, Greeley, July 22, 1907, *E. L. Johnson* 246 (MBG); Fort Collins, alt. 5000 ft., June 30, 1894, *Baker* (P); fields, south of Castle Rock, Douglas Co., June 24, 1929, *Woodson & Anderson* 29100 (MBG); south of Lyons, Boulder Co., June 23, 1929, *Woodson & Anderson* 29109 (MBG); roadside near mouth of North St. Vrain Canyon, west of Lyons, Boulder Co., July 25, 1929, *Woodson & Barnhart* 29029 (MBG).

NEW MEXICO: Roswell, moist ground, May 26, 1916, *Peacock* 56 (F); Las Vegas, July, 1881, *Vasey* (ND); Gilmore's Ranch, Otero Co., July 14, 1895, *Wooton* (US, P); headwaters of Cimarron River, June 13, 1846, *Wislizenus* 458 (MBG); Mesilla Valley, Dona Ana Co., Apr. 29, 1906, *Standley* 14 (US, MBG); Cimarron Canyon, June 30, 1929, *Mathias* 558 (MBG).

IDAHO: Boise, loamy slope, alt. 2880 ft., June 17, 1910, *Macbride* 247 (G, MBG, W); shores, south end of Lake Pend d'Oreille, Aug. 4, 1892, *Sandberg, MacDougal & Heller* 825 (G, US); rocky hillsides, Three Creek, Idaho Co., May 18, 1926, *Ransom & Ridout* 146 (W).

UTAH: Murray, Salt Lake Co., July 18, 1917, *M. E. Jones* (P, G); Red Butte, July 11, 1908, *Clemens* (ANSP); Peterson Canyon, Peterson, alt. 8000-10000 ft., July 19, 1902, *Pammel & Blackwood* 4009 (MBG); Provo, alt. 4500 ft., June 25, 1894, *M. E. Jones* 5490 (P, MBG).

NEVADA: Caliente, moist sides of a canyon, May 29, 1902, *Goodding* 986 (G, P, MBG, US, NY); Beattie, elev. 3500 ft., June 5, 1912, *Heller* 10417 (MBG); Reno, alt. 4500 ft., June 11, 1897, *M. E. Jones* (P); Palisade, June 14, 1882, *M. E. Jones* (P); Pallon. along ditches, July 31, 1919, *Tidestrom* 10791 (F).

ARIZONA: Clemenceau, May 22, 1922, *W. W. Jones* 79 (G).

OREGON: Clearwater, date lacking, *Spaulding* (G, MBG).

CALIFORNIA: Mt. Tejon and vicinity, 1857-58, *Vesey* 100 (NY); Yosemite Valley, June 19, 1863, *Brewer* 1673 (US); Humboldt Co., date lacking, *Chestnut & Drew* (ND); Glenn Co., July 7, 1914, *Heller* 11532 (G, MBG); Sespe Creek, Ventura Co., alt. 2300-2500 ft., June 9, 1908, *Abrams & MacGregor* 184 (G, MBG, US, NY); Los Gatos, foothills, Santa Clara Co., June 16, 1904, *Heller* 7518 (G, MBG, NY, D, ANSP, F); Cuyamaca Lake, San Diego Co., June 26, 1903, *Abrams* 3913 (NY, G, MBG); Grass Valley, Nevada Co., July 14, 1905, *Heller* 8109 (G, NY, ANSP, F, MBG); Table Mountain, Olive Ranch, north of Oroville, Butte Co., June 4, 1913, *Heller* 10779 (G, NY, ANSP, US, F, MBG); "Indian Rock," Fern Valley, San Jacinto Mts., alt. 6000 ft., July 18, 1923, *Spencer* 2360 (G); Cold Water Canyon, San Antonio Mts., San Bernardino Mts., July 12, 1902, *Abrams* 2709 (G, NY, ANSP, MBG); Mud Flat, on the Newville-Covelo road, July 7, 1914, *Heller* 11532 (MBG, NY, ANSP, F, US); Tessajara Hot Springs, Monterey Co., June, 1901, *Elmer* 3180 (MBG, US); Lytle Creek, San Bernardino Co., alt. 7000 ft., July 24, 1901, *Abrams* 1941 (P); near springy place near Palomar Hotel, Palomar Mt., San Diego Co., alt. 5000 ft., June 23, 1924, *Munz* 8324 (P); Twenty-nine Palms, wet meadow, alt. 3000 ft., May 1, 1921, *Munz* 4517 (P).

EXCLUDED SPECIES

Apocynum Acouci Aubl. Pl. Guian. 1: 274. 1775 = *Forsteronia Acouci* (Aubl.) A. DC. in DC. Prodr. 8: 439. 1844.

Apocynum africanum Lour. Fl. Cochinch. 1: 168. 1790 = *Ichnocarpus africanus* (Lour.) Woodson, n. comb. (*Ichnocarpus Loureiri* Spreng. Syst. 1: 635. 1825).

Apocynum agglomeratum Poir. Encycl. 1: 407. 1810 = *Marsdenia Clausa* R. Br. Mem. Wern. Soc. 1: 30. 1809.

Apocynum alterniflorum Lour. Fl. Cochinch. 1: 168. 1790 = *Gymnema sylvestris* (Willd.) R. Br. Mem. Wern. Soc. 1: 33. 1809.

Apocynum androsaemifolium Forsk. Fl. Aeg.-Arab. 22. 1775, non L. = *Trachomitum venetum* (L.) Woodson, Ann. Mo. Bot. Gard. 17: 158. 1930.

Apocynum angustifolium Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 40. 1893 = *Funastrum bicolor* (Decne.) Macbr. Contr. Gray Herb. N. S. 49: 50. 1917.

Apocynum apiculatum Lam. Encycl. 1: 214. 1783 = *Forsteronia Acouci* (Aubl.) A. DC. in DC. Prodr. 8: 439. 1844.

Apocynum bursiflorum Noronha, Verh. Batav. Gen. ed. 1, 5: 5. 1790 = *Strophanthus* sp.?

Apocynum canariense Lam. Encycl. 1: 212. 1783 = *Gomphocarpus* sp.?

Apocynum citrifolium Descourt. Fl. Med. Antill. 3: 180. t. 191. 1827 = *Marsdenia fusca* Wright ex Griseb. Cat. Pl. Cub. 178. 1866 (?).

Apocynum compressum Moench, Meth. 464. 1794 = *Trachomitum venetum* (L.) Woodson, Ann. Mo. Bot. Gard. 17: 158. 1930.

Apocynum cordatum Mill. Gard. Dict. ed. 8. 1768, *non* Thunb. = *Rhabdadenia cordata* (Mill.) Miers, Apoc. S. Am. 122. 1878.

Apocynum cordatum Thunb. Prodr. Pl. Cap. 47. 1775, *non* Mill. = *Astephanus cordatus* (Thunb.) R. Br. Mem. Wern. Soc. 1: 54. 1809.

Apocynum cordifolium Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 39. 1893, *non* Tenore = *Prestonia* sp.?

Apocynum cordifolium Tenore, ex Steud. Nom. Bot. ed. 2, 1: 113. 1841, *non* Sesse & Mociño = *Astephanus cordatus* (Mill.) R. Br. Mem. Wern. Soc. 1: 54. 1809.

Apocynum cotinifolium Tenore, ex Steud. Nom. Bot. ed. 2, 1: 113. 1841 = *Ichnocarpus* sp.?

Apocynum crassifolium Salisb. Prodr. 149. 1796 = *Ichnocarpus frutescens* (L.) R. Br. Mem. Wern. Soc. 1: 62. 1809.

Apocynum cumanense Willd. ex Roem. & Schult. Syst. 6: 796. 1820 = *Metaplexis fimbriata* (Kunth) Spreng. Syst. 1: 854. 1825.

Apocynum erectum Vell. Fl. Flum. 3: 123. t. 87. 1827 = *Barjonia erecta* (Vell.) K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 285. 1895.

Apocynum filiforme Thunb. Prodr. Pl. Cap. 47. 1775 = *Eustegia filiformis* (Thunb.) Roem. & Schult. Syst. 6: 120. 1820.

Apocynum fimbriatum Sesse & Mociño, Fl. Mex. 78. 1894 = *Prestonia contorta* (Mart. & Gal.) Hemsl. Biol. Centr.-Am. Bot. 2: 311. 1881.

Apocynum floristratum Noronha, Verh. Batav. Gen. 5: 5. 1790
= *Strophanthus* sp.?

Apocynum foetidum Burm. Fl. Ind. 71. 1768 = *Paederia foetida* L. Mant. 1: 52. 1767.

Apocynum fructu spinoso Descourt. Fl. Med. Antill. 3: 171. 1827 = *Ibatia maritima* (Jacq.) Decne. in DC. Prodr. 8: 599. 1844.

Apocynum frutescens Afzel. Remed. Guin. Coll. 4: 28. 1813, non L. = *Ichnocarpus Afzelii* Roem. & Schult. Syst. 4: 399. 1819.

Apocynum frutescens L. Sp. Pl. ed. 1, 213. 1753, non Afzel. = *Ichnocarpus frutescens* (L.) R. Br. Mem. Wern. Soc. 1: 62. 1809.

Apocynum grandiflorum Danguy in Lecomte, Not. Syst. 2: 137. 1911 = *Poacynum grandiflorum* Danguy in Lecomte, l. c. 1911.

Apocynum hastatum Thunb. Prodr. Pl. Cap. 47. 1775 = *Eustegia hastata* (Thunb.) R. Br. Mem. Wern. Soc. 1: 51. 1809.

Apocynum Hendersonii Hook. f. in Hume & Henders. Lahore to Yarkand, 327. 1873 = *Poacynum Hendersonii* (Hook. f.) Woodson, Ann. Mo. Bot. Gard. 17: 167. 1930.

Apocynum imbricatum Sesse & Mociño, Fl. Mex. 77. 1894 = *Funastrum bicolor* (Decne.) Macbr. Contr. Gray Herb. N. S. 49: 50. 1917. (?)

Apocynum indicum Lam. Encycl. 1: 214. 1783 = *Eustegia hastata* (Thunb.) R. Br. Mem. Wern. Soc. 1: 51. 1809.

Apocynum Juventas Lour. Fl. Cochinch. 167. 1790 = *Tylophora Juventas* (Lour.) Woodson, n. comb. (*Tylophora ovata* Hook. ex Steud. Nom. Bot. ed. 2, 2: 726. 1841.

Apocynum lanceolatum Thunb. Prodr. Pl. Cap. 47. 1775 = *Astephanus lanceolatus* (Thunb.) R. Br. Mem. Wern. Soc. 1: 54. 1809.

Apocynum lineare L. f. Suppl. 1: 169. 1781 = *Astephanus linearis* (L. f.) R. Br. Mem. Wern. Soc. 1: 54. 1809.

Apocynum maculatum Descourt. Fl. Med. Antill. 3: 176. t. 190. 1827 = *Marsdenia Clausa* R. Br. Mem. Wern. Soc. 1: 30. 1809.

Apocynum mexicanum Sesse & Mociño, Pl. Nov. Hisp. ed. 2, 39. 1893 = *Funastrum bicolor* (Decne.) Macbr. Contr. Gray Herb. N. S. 49: 50. 1917.

Apocynum minutum L. f. Suppl. 1: 169. 1781 = *Eustegia hastata* (Thunb.) R. Br. Mem. Wern. Soc. 1: 51. 1809.

Apocynum mucronatum Blanco, Fl. Filip. ed. 1, 852. 1827 = *Toxocarpus mucronatus* (Blanco) Woodson, n. comb. (*Toxocarpus gracilis* Decne. in DC. Prodr. 8: 505. 1844).

Apocynum Nerium Aubl. Pl. Guian. 1: 277. 1775 = *Anechites Nerium* (Aubl.) Urb. in Fedde, Repert. Sp. Nov. 16: 150. 1919.

Apocynum nervosum Mill. Gard. Dict. ed. 8. 1768 = *Rhabdenia nervosa* (Mill.) Miers, Apoc. S. Am. 122. 1878.

Apocynum obliquum Mill. l. c. 1768 = *Echites umbellata* Jacq. Enum. Pl. Carib. 13. 1760.

Apocynum odoratissimum Lour. ex Pritz. Icon. Ind. 83. 1865 = *Telosma odoratissima* (Lour.) Coville, Contr. U. S. Nat. Herb. 9: 384. 1905.

Apocynum orixense Rottl. ex Hook. f. Fl. Brit. Ind. 4: 6. 1885, nomen. = *Cryptolepis elegans* Wall. ex Hook. f. l. c. 1885.

Apocynum paniculatum Lam. Encycl. 1: 214. 1783, non Greene = *Forsteronia Acouci* (Aubl.) A. DC. in DC. Prodr. 8: 439. 1844.

Apocynum pictum Schrenk, Bull. Phys.-Math. Acad. Petersb. 2: 115. 1844 = *Poacynum pictum* (Schrenk) Baill. Bull. Soc. Linn. Paris 1: 757. 1888.

Apocynum platyanthum Salzm. ex Decne. in DC. Prodr. 8: 594. 1844 = *Funastrum cynanchoides* (Gr.) Schltr. in Fedde, Repert. Sp. Nov. 13: 284. 1914.

Apocynum proliferum Sesse & Mociño, Pl. Nov. Hisp. ed. 2. 39. 1893 = *Funastrum* sp.?

Apocynum rectinerve Salzm. ex Decne. in DC. Prodr. 8: 603. 1844 = *Blepharodon pallidum* Decne. in DC. Prodr. l. c. 1844.

Apocynum reticulatum L. Sp. Pl. ed. 1, 214. 1753, non Wall. = *Parsonia reticulata* (L.) Woodson, n. comb. (*Parsonia Heliandra* Hook. & Arn. Bot. Beechey's Voy. 197. 1836.)

Apocynum reticulatum Wall. Cat. n. 8247. 1832, nomen, non L. = *Decalepis Hamiltonii* Wight & Arn. Contr. 64. 1834.

Apocynum salicifolium Medic. Act. Acad. Theod. Palat. 6: 406. 1790 = *Gomphocarpus fruticosus* (L.) R. Br. Mem. Wern. Soc. 1: 38. 1809.

Apocynum salicifolium Willd. ex Roem. & Schult. Syst. 6: 796. 1820, non Medic. = *Marsdenia Clausa* R. Br. Mem. Wern. Soc. 1: 38. 1809.

Apocynum scandens Mill. Gard. Dict. ed. 8. 1768 = *Marsdenia Clausa* R. Br. Mem. Wern. Soc. l. c. 1809.

Apocynum sibiricum Pall. ex Roem. & Schult. Syst. 4: 405. 1819 = *Trachomitum venetum* (L.) Woodson, Ann. Mo. Bot. Gard. 17: 158. 1930.

Apocynum soleare Noronha, Verh. Batav. Gen. ed. 1, 5: 5. 1790 = *Strophanthus* sp.?

Apocynum speciosissimum Mill. Gard. Dict. ed. 8. 1768 = *Urechites lutea* (L.) Britton, Bull. N. Y. Bot. Gard. 5: 316. 1907.

Apocynum stellatum Noronha, Verh. Batav. Gen. ed. 1, 5: 51. 1790 = *Decalepis* sp.?

Apocynum stylospermum Noronha, l. c. 1790 = *Decalepis* sp.?

Apocynum syriacum S. G. Gmel. Reise 2: 198. 1774 = *Calotropis syriaca* (S. G. Gmel.) Woodson, n. comb. (*Calotropis procera* Ait. Hort. Kew. ed. 2, 78. 1811).

Apocynum tiliaefolium Lam. Encycl. 1: 214. 1783 = *Dregea volubilis* Benth. ex Hook. f. Fl. Brit. Ind. 4: 46. 1885.

Apocynum triflorum L. f. Suppl. 1: 169. 1781 = *Astephanus triflorus* (L. f.) R. Br. Mem. Wern. Soc. 1: 54. 1809.

Apocynum umbellatum Aubl. Pl. Guian. 1: 275. 1775 = *Thenardia umbellata* (Aubl.) Spreng. Syst. 1: 636. 1825.

Apocynum umbellatum Salz. ex Decne. in DC. Prodr. 8: 585. 1844, non Aubl. = *Oxypetalum densiflorum* Decne. l. c. 584. 1844.

Apocynum Uralense Gandoger, Nov. Conspect. 333. 1910, nomen. = *Trachomitum venetum* (L.) Woodson, Ann. Mo. Bot. Gard. 17: 000. 1930.

Apocynum venetum L. Sp. Pl. ed. 2, 213. 1753 = *Trachomitum venetum* (L.) Woodson, l. c. 1930.

Apocynum venetum L. var. *anomalum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 76. 1913 = *Trachomitum venetum* (L.) Woodson, l. c. 1930.

Apocynum venetum L. var. *brachycarpum* Bég. & Bel. l. c. 1913 = *Trachomitum venetum* (L.) Woodson, l. c. 1930.

Apocynum venetum L. var. *ellipticifolium* Bég. & Bel. l. c. 75. 1913 = *Trachomitum venetum* (L.) Woodson var. *ellipticifolium* (Bég. & Bel.) Woodson, l. c. 1930.

Apocynum venetum L. var. *latifolium* Bég. & Bel. *l. c.* 71. 1913
 = *Trachomitum venetum* (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *longifolium* Bég. & Bel. *l. c.* 1913 =
Trachomitum venetum (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *microphyllum* Bég. & Bel. *l. c.* 76.
 1913 = *Trachomitum venetum* (L.) Woodson var. *microphyllum*
 (Bég. & Bel.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *oblongifolium* Bég. & Bel. *l. c.* 71.
 1913 = *Trachomitum venetum* (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *scabrum* Bég. & Bel. *l. c.* 76. 1913
 = *Trachomitum venetum* (L.) Woodson, *l. c.* 1930.

Apocynum venetum L. var. *turkestanicum* Bég. & Bel. *l. c.* 1913
 = *Trachomitum venetum* (L.) Woodson, *l. c.* 1930.

Apocynum villosum Mill. Gard. Dict. ed. 8. 1768 = *Mandevilla* sp.?

Apocynum viminale Bassi in Comm. Bonon. (1753), *ex* Roem.
 & Schult. Syst. 6: 113. 1820 = *Sarcostemma viminalis* (Bassi)
 R. Br. Mem. Wern. Soc. 1: 51. 1809.

Apocynum vincaeifolium Burm. f. Fl. Ind. 71. 1768 = *Wrightia*
 tinctoria R. Br. Mem. Wern. Soc. 1: 73. 1809. (?)

Apocynum volubile Vell. Fl. Flum. 123; 3: t. 88. 1827 =
Arauja sericifera Brot. Trans. Linn. Soc. 12: 62. 1818.

ABBREVIATIONS

In the preceding taxonomic treatment of the genus *Apocynum*, the various herbaria in which specimens have been examined are noted as follows:

MBG	= Herbarium of the Missouri Botanical Garden.
G	= Gray Herbarium of Harvard University.
NY	= Herbarium of the New York Botanical Garden.
US	= United States National Herbarium.
F	= Herbarium of the Field Museum of Natural History.
ANSP	= Herbarium of the Academy of Natural Sciences of Philadelphia.
P	= Herbarium of Pomona College.
D	= Herbarium of C. C. Deam, Bluffton, Indiana.
W	= Herbarium of the State College of Washington.
ND	= Edward L. Greene Herbarium of the University of Notre Dame
NS	= Herbarium of the Provincial Museum of Nova Scotia
NE	= Herbarium of the New England Botanical Club.
Epling Herb.	= Herbarium of Dr. Carl C. Epling.

LIST OF EXSICCATAE

The distribution numbers are printed in *italics*. Unnumbered collections are indicated by a dash. The numbers in parentheses are the species numbers used in this monograph.

Abrams, L. R. *701* (2); *1941*, *2709* (7c); *2775* (2a); *3913* (6b); *4549* (3d); *4580* (2a); *4660* (3c); *5865*, *8629* (2); *9338* (2a).
 Abrams, L. R. & MacGregor, E. A. *184* (7c); *774* (1a).
 Adrien, Fr. *1094* (3); *21986* (7).
 Alexander, H. & Kellogg, L. *209* (2).
 Anderson, E. *2700* (1a); — (3b).
 Anderson, E. & Woodson, R. E. Jr. *5005* (7b); *5013* (6a); *5040* (6).
 Anderson, J. P. — (6b).
 Anderson, J. R. — (1a); *500* (1a).
 Andrews, L. — (3); — (6a); — (7).
 Applegate, E. I. *447* (2).
 Arthur, J. C. — (6); *23* (6b); — (7); — (10).
 Ashe, W. W. — (1a).
 Ashecroft, — (7).
 Austin, Mrs. R. M. — (2); *1458* (2a); *1683* (3c).
 Babcock, H. H. — (1a).
 Bailey, V. *444* (3c).
 Bain, S. M. *160* (6a).
 Baker, C. F. — (1a); *80* (7c); *202* (1); *372* (3d); *526* (3c); *527* (1a); *799* (1a); *1122* (2); *1209* (2a); *1220* (3c); *1252* (2a); *1461* (2); *1508* (3c); *3247* (6a).
 Baker, C. F., Earle, F. S. & Tracy, S. M. *429* (3d); *840* (1a).
 Baker, H. P. — (7).
 Baker, M. S. — (2).
 Ball, J. — (1a).
 Banks, R. R. *21* (1a).
 Bardell, E. M. & Frye, T. C. — (1).
 Barlow, B. — (1a).
 Bartlett, H. H. *1124*, *1464*, *1476* (6b); *1661* (6a); *1690*, *1768* (6).
 Bartram, E. B. — (1a); — (6b); — (7); *1007* (6).
 Bartsch, P. — (3).
 Batchelder, C. F. — (1a); — (7).
 Bates, J. M. — (7).
 Beardslee, H. C. — (1a).
 Beattie, R. K. — (2a).
 Beattie, R. K. & Chapman, R. *2067* (2).
 Beattie, R. K. & Lawrence, W. H. — (2).
 Bebb, R. — (6a).
 Bergman, H. F. *1932* (7).
 Bergmann, L. S. — (6b).
 Beyerich, H. K. — (3).
 Bicknell, E. P. — (3).
 Bigelow, J. *691* (6b).
 Biltmore Herb. *79b* (6); *80b* (1a); *79* (7).
 Bissell, C. H. — (1a); — (3); — (6); — (6a); — (7).
 Bissell, C. H., Pease, A. S. & Long, B. *22315* (1a).
 Blake, S. F. *2844* (3).
 Blanchard, S. F. — (1a); — (7).
 Blankinship, J. W. — (1a); — (6b).
 Blewitt, A. E. *3674* (1a).
 Blumer, J. C. *1543* (1a).
 Boettcher, F. L. *141* (6a).
 Boice, C. A. — (1a).
 Boot, W. — (1a); — (7).
 Bourgeau, E. — (1a); — (7).
 Brainerd, E. — (7).
 Brand, C. J. *591* (1a).
 Brandegee, K. — (2).
 Brandegee, T. S. — (1a); *472* (6b).
 Brannon, M. A. — (7b).
 Bray, W. L. *216* (7).
 Brewer, W. H. *1673* (7c).
 Bridges, T. *160* (1).
 Britton, N. L. — (1a); —, *48* (6a); — (6b).
 Britton, N. L., Britton, E. G. & Vail, A. M. — (1a).
 Broadhead, G. C. — (3); — (6b).
 Brown, H. E. — (2).
 Brown, R. B. — (2).
 Brown, S. —, *655* (1a).
 Bruce, Mrs. C. C. —, *2093* (6a).
 Burgess, A. B. *62* (1a).
 Bush, B. F. *15* (1a); *11* (3b); *159* (6b); *243*, *314* (6a); *338* (3); *359* (6b); *363* (6a); *809* (7); *916*, *2947* (3b); *4083* (6a); *5849* (6a); *5871* (1a); *7053* (6a); *7611* (7b); *7615* (3); —, *9054* (6b).

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 Campbell, J. E. — (1a).
 Canby, W. M. — (6b); 226 (1); —, 3422 (6).
 Carr, J. C. —, 95 (1a).
 Carter, J. J. — (3); — (6); — (6a); — (7).
 Chamberlain, E. B. — (7).
 Chamberlain, E. B. & Knowlton, C. H. — (7).
 Chandonnet, Z. L. — (1a).
 Chaney, R. W. 92 (1a).
 Chapman, A. W. — (6b).
 Chase, A. — (1a).
 Chase, V. H. 647 (1a); 631 (6a).
 Chestnut, V. K. & Drew, E. R. — (7c).
 Churchill, J. R. — (1a); — (3).
 Clark, J. A. 101 (2); 113 (6b); 243, 330 (2).
 Clemens, Mrs. J. E. — (1); — (2); — (3b); — (1a); — (7c); 11728 (6b).
 Clements, F. E. & Clements, E. S. 107, 398 (1a).
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 Clute, W. N. 87 (5).
 Coghill, G. E. 96 (1a).
 Coker, W. C. — (6a).
 Collins, J. F. & Fernald, M. L. — (3); — (7).
 Collins, J. F., Fernald, M. L. & Pease, A. S. — (3); 5877 (1a).
 Collins, J. F. & Hope, T. — (3).
 Commons, A. — (1a); — (6).
 Conger, K. — (2).
 Copeland, E. B. 5544 (2).
 Cotton, J. S. 1399 (6b).
 Coues, E. & Palmer, E. — 332 (6b).
 Coville, A. L. — (6b); — (7).
 Coville, F. V. — (1a); — (7).
 Cowles, H. C. 380 (2a).
 Cowley, K. — (2).
 Crandall, C. S. — (3c); — (6b); 1013 (1).
 Crawford, D. L. — (1a).
 Cronkhite, H. M. 76 (2).
 Culbertson, — 4472 (2).
 Curtis, C. D. — (1a).
 Curtiss, A. H. — (1a).
 Cushman, J. A. & Sanford, S. N. F. 1621, 1296 (1a).
 Daniels, F. 409 (3c).
 Davis, J. 1326 (6b); 2263 (3b); 2947 (6a); 2969 (3b); 4762 (6a); 4984, 8426 (6).
 Davison, R. T. — (2).
 Day, M. A. 19, 70 (1a); — (7).
 Deam, C. C. — (1a); — (3); — (6a); — (6b); — (7); — (7a); 11 (6); 73 (3); 1125 (1a); 1168 (7a); 2276, 6901 (6); 8489 (6a); 8848, 8923, 8997 (1a); 9135, 11566 (6b); 11902 (3); 12405, 13280, 13500 (7); 13517 (6a); 13562 (6); 13673 (6a); 13766 (6b); 13806 (6a); 14283 (1a); 17004 (6b); 17217 (6); 17555 (6b); 17879 (3); 20348 (6a); 20524 (6); 20571 (3a); 20972, 21571 (3); 25230 (6a); 25405 (6); 25609 (7); 25647 (6a); 25904, 25905, 27862 (3); 31710 (1a); 31973, 32972 (7); 34434, 39168 (3a); 41020 (3b); 41320, 41548 (1a); 44912 (6a).
 Deam, C. C. & Gleason, H. A. — (7a); — (6a).
 Dodge, C. K. — (3a).
 Donnell-Smith, J. — (1a); — (7).
 Dorner, H. B. — (3).
 Driggs, A. W. — (1a); —, 2326 (7).
 Drummond, T. 232 (6b).
 Drushel, J. A. 2434 (1a).
 Dutton, E. L. — (6b).
 Eames, A. J. & McDaniels, L. H. 964 (7); 4832 (3).
 Eames, A. J. & Wiegand, K. M. 12761 (6a).
 Eames, E. H. — (1a); — (6); — (6a); 8786 (3).
 Earle, F. S. 1644 (6a).
 Eastwood, A. 71 (5a); 542, 906 (3c); 13363 (2).
 Eaton, L. O. — (3); — (6).
 Eby, A. F. — (1a); — (6b).
 Eggert, H. — (1a); — (3); — (6a); — (6b).
 Eggleston, W. W. 3291 (1a); 4805 (6a); 4872 (7).
 Eggleston, W. W. & Grout, A. J. 2060 (7).
 Ehlers, J. H. 559 (1a).
 Eisenhower, C. W. — (6b).
 Elmer, A. D. E. — (5); 138 (1); 285 (3c); 507 (6b); 2216 (1); 3180 (7c); 6863 (1).

Elrod, M. J. — (1a).
 Emig, W. H. 378 (7).
 Engelmann, G. — (1a); — (2); — (6b); — (7).
 Engelmann, H. — (6b); — (7b).
 English, C., Jr. 775 (2).
 Epling, C. C. 5574, 6088, 7122 (1a); 10426 (2); 10461 (3c).
 Epling, C. C. & Houck, M. — (2); 9408 10004 (3c).
 Epling, C. C., Houck, M. & Putnam, —. 10119 (2).
 Evans, W. H. — (1).
 Evermann, B. W. — (6).
 Farwell, O. A. — (1a); — (3); — (6); — (7a).
 Farwood, —. 252 (1).
 Faxon, C. E. — (1a); — (7); — (11).
 Fendler, A. — (1a); 690 (1); 690.6 (3); 898 (6b).
 Fernald, M. L. — (1); — (1a); — (3); 37 (7); 245 (1a); 375 (6b); —, 2073, 2074, 2076 (7); 2075 (3).
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 Fernald, M. L., Dodge, C. W. & Smith, L. B. 25988 (1a).
 Fernald, M. L., Hunnewell, F. W. 2d., & Long, B. 10241 (6a); 10243 (3).
 Fernald, M. L. & Long, B. 10240 (1a); 10241 (6a); 14398, (1a); 14399 (3); 14402, 14404, 14406 (7); 14400, 19008, 24392 (3).
 Fernald, M. L. & Pease, A. S. 25241 (7).
 Fernald, M. L. & St. John, H. 7950 (1a).
 Fernald, M. L. & Wiegand, K. M. 6087, 6088 (1a); 6089, 6090 (3); 6092 (7).
 Ferris, R. S. & Duncan, C. D. 2542 (1).
 Fink, B. — (1a).
 Fisher, G. L. — (6a).
 Fitch, A. — (1a); — (6b); — (7).
 Forbes, F. F. — (7).
 Fowler, J. — (7).
 French, C. — (6).
 Fuller, T. O. — (7).
 Furbish, K. — (1a); — (3); — (7).
 Garesche, E. E. — (1a).
 Garrett, A. O. 2450 (1); 2915 (3c).
 Gilmour, J. — (1a).
 Glatfelter, N. M. — (1a); — (6a); 338, (6b).
 Gleason, H. A. —, 336 (1a); 687 (7).
 Goldman, E. A. 1221 (1a).
 Goodding, L. N. 120 (1a); 988 (7c); 1127, 1622 (1a).
 Goodwin, L. L. 12 (2a).
 Grant, J. M. — (1a); — (2a).
 Graves, C. B. — (3); — (6a).
 Gray, A. — (6b).
 Greene, E. L. — (1a); — (2); — (2a); — (3); — (3c); — (3e); — (6); — (6a); — (6b); — (7).
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 Greenman, M. T. 52 (1a).
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 Haberer, J. V. 2202 (7); 3559 (3).
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 Hall, E. 427 (2a); 514 (6b).
 Hall, H. M. & Chandler, H. P. 146 (2).
 Hammond, E. W. 274 (2a); 275 (3e).
 Hanson, G. — (2); 27, 585 (3c); 938, 969 (2).
 Hanson, H. C. 158 (3); 276 (1); 277 (3c).
 Harms, E. L. — (2a).
 Harris, J. A. 16394 (1a).
 Harrison, L. C. — (1a).
 Harwood, R. D. 4328 (3d).
 Hasse, H. E. — (6a); — (6b).
 Hedgecock, G. G. — (6b); — (7c).
 Heller, A. A. — (2a); 464 (6a); 970 (6); 7050 (2a); 8109 (7c); 8110 (3c); 7518 (7c); 8036 (2a); 9815 (3c); 9940 (5); 5738 (6b); 10612 (5); 10779, 10417 (7c); 10883 (3c); 10982 (1); 11532 (7c); 11978 (2a); 11936 (2); 18753, 12887, 12963 (2a); 13067, 13345, 13753 (2); 13988 (7b); 13998, 14103 (6a); 14204, 14232 (1a); 14239 (6a); 14240 (7); 14258 (1a); 14261 (3).
 Heller, A. A. & Halbach, G. 1039 (7); 3338 (2a).
 Henderson, L. F. 310 (2); 649 (6b).
 Hexamer, A. C. & Maier, F. W. — (6a).
 Hicks, —. — (7).

Hill, A. F. 1540 (1a).
 Hillman, F. H. — (2).
 Hitchcock, A. S. — (1a); — (6); — (6a); 12909 (6b); — (7).
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 Hoffman, R. — (3); — (6); — (6b); — (7).
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 Hope, T. — (7); 453 (1a).
 Horner, R. M. 334 (2).
 House, H. D. 1007 (6a); 1208 (1a); 1060 (6); 2822 (7); 8100 (7a); 8294 (1a).
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 Howell, A. H. — (1a).
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 Hubbard, F. T. — (1a).
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 Jepson, W. L. — (2a).
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 Jones, M. E. — (1); — (1a); — (2); — (3c); — (4); — (5); — (6b); — (7c); 237 (3c); 572 (1); 1272, 1863 (5); 5490 (6b); 5490, in part, (7c); 5560, 5613 (1); 6447 (2); 8878 (7c); 8880, 8881 (1).
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 Kellogg, A. & Harford, W. G. 848 (1a); 4870 (2).
 Kellogg, J. H. — (1a); — (6); — (6b); 470 (6); 471 (3b).
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 Kennedy, G. G. — (1a); — 50 (3).
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 Kent, E. C. — (1a); — (7).
 Keyes, E. — (2).
 King, M. A. 247 (3c).
 Kirkwood, J. E. 1252, 1253, 1594 (2).
 Knowlton, C. H. — (1a); — (7).
 Kreager, F. O. 89 (1a).
 Lake, —. & Hull, W. R. 542 (3d).
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 Lemmon, J. G. — (1a).
 Leonard, F. E. — (1).
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 Lindheimer, F. 658 (6b); 659 (6).
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 Mackenzie, K. K. & Griscom, L. 10418 (7).
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 Menke, H. W. — (7).

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 (7c); 8274 (2a); 8324 (7c); 8417 (6b).
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 Nelson, A. & Macbride, J. F. 1361 (6b).
 Nelson, A. & Nelson, E. 6206 (1a); 6923
 (7c).
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 Newcombe, C. F. 293 (7c).
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 Nieuwland, J. A., Slavin, A. & Woodson,
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 6092 (6a); 8133 (6b); 9893 (6); 12420
 (6b); 13849, 15926 (7); 17528 (6a);
 18293 (3); 18311 (6b); 23248 (1a);
 28651 (1a); 3188 (6b); 34081 (3c);
 34233 (7); 34676 (6a); 34692 (1a).
 Palmer, W. — (3); 7 (6a).
 Pammel, L. H. — (7b); 5 (1); 864 (1a).
 Pammel, L. H. & Blackwood, R. E. 4009
 (6b).
 Pammel, L. H. & Stanton, E. M. 71
 (1).
 Parish, S. B. 11427 (6b).
 Parlin, J. C. — (3); 2386 (7).
 Parry, C. L. — (6a).
 Patterson, H. J. 6863 (1).
 Payson, E. B. 116 (7c); 178 (1a); 1172
 (1a).
 Payson, E. B. & Armstrong, G. M. 5382
 (2).
 Payson, E. B. & Payson, L. B. 1886,
 2170, 2186 (1).
 Peacock, B. R. 56 (7c).
 Pease, A. S. 1089, 2267, 11332 (7); 17345
 (1a); 17383 (3); 18104 (7).
 Pease, A. S. & Long, B. 22317 (7).
 van Pelt, S. S. — (1a).
 Peck, M. E. 2945 (2a); 8004 (2); 8944
 (2a); 10172 (3c).
 Penard, —. 500 (1).
 Perry, R. C. — (1a); — (6a).
 Peter, R. — (6b).
 Phelps, O. P. — (1a); 783, 1690 (7).
 Pierce, W. M. — (1a).
 Piper, C. V. 3508 (2); 3702 (6b); 3786
 (1).
 Plank, E. N. — (6b).
 Pollard, C. L. & Maxon, W. R. — (6b).
 Pollock, W. M. — (1a); — (6c).
 Pool, R. & Williams, —. — (3).
 Poole, S. F. 36 (6b).
 Poole, S. F. & Folsom, —. — (7).
 Porter, T. C. — (6); — (6b); — (7).
 Powell, H. O. — (1a); — (7).
 Preble, E. & Preble, A. 175 (1a).
 Preble, E. & Mixter, G. 549 (1a).
 Prescott, H. S. — (2).
 Price, S. F. — (6b).
 Quaintance, A. L. — (6b).
 Rand, E. L. — (1a).
 Randolph, L. F. & Randolph, F. R. 481
 (6); 1240 (7); 1356 (6b).
 Ransom, B. & Ridout, L. 146 (7c).
 Rau, E. A. 66 (1a).
 Ravenel, H. W. — (6a).
 Redfield, J. R. 4871 (6a).

Reverchon, J. — (3); —. 599 (6b); 4309 (7).
 Rhoads, S. W. — (1a).
 Ricksecker, —. — (6).
 Ridgway, R. 2832 (6b).
 Robinson, B. L. — (7); 11 (3); 135 (7); 362 (6); 563 (6b); 741 (1a).
 Robinson, B. L. & Schrenk, H. [von] 96 (1a).
 Robinson, C. B. 502 (7).
 Robinson, T. R. & Maxon, W. R. 37 (1a).
 Rolfs, P. H. 720 (3).
 Rolland, Fr. 142 (7).
 Rolland, Fr. & Germain, Fr. — (7).
 Rose, J. P. 2 (1a); 1588 (2).
 Rosendahl, C. O. 1835 (1a).
 Rothrock, J. T. & Wolf, —. 45 (1a).
 Rusby, H. H. — (6a).
 Rust, H. J. 247 (1).
 Ruth, A. 387, 463 (6a); 481 (6b); 501 (6); 5088 (6a).
 Rydberg, P. A. — (6b); —, 95, 130 (1a); 871 (1); 1553 (7); 6772, 7761 (1); 7892 (3).
 Rydberg, P. A. & Bessey, E. A. 4701 (1).
 Rydberg, P. A. & Vreeland, F. R. 5756 (1a).
 Sandberg, H. J. — (1a); — (6b).
 Sandberg, H. J. & Leiberg, J. B. 591 (3c).
 Sandberg, H. J., MacDougal, D. T. & Heller, A. A. 372 (2); 825 (7c).
 Sanford, S. N. F. — (1a).
 Sartwell, H. P. — (3).
 Saunders, W. E., Anderson, E. & Woodson, R. E., Jr. — (1a).
 Savage, T. E. & Steele, E. S. 310 (1a).
 Savage, T. E., Cameron, F. E. & Lenocker, J. E. — (2a).
 Scheuber, E. W. — (1a); 1 (1).
 Scheutte, J. H. — (1a); — (6a); — (7).
 Schenck, — (6).
 Schrenk, H. [von] — (1a); — (6b).
 Scribner, F. L. 151 (7c); 158 (2).
 Seymour, F. C. 53, 1431 (1a); 200 (6b).
 Sharples, S. P. 181 (2).
 Shaw, C. H. 630 (1); 1064 (1a).
 Shear, C. L. 88 (7); 4808 (6b).
 Sheldon, E. P. 8208 (1).
 Short, C. W. — (6b).
 Shull, G. H. 109, 173 (6b).
 Sinnott, E. W. — (3).
 Sleeper, T. S. — (1a).
 Small, J. K. — (6); — (7).
 Smiley, F. J. 247 (3c).
 Smith, B. H. — (1); — (2).
 Smith, E. C. — (1a); — (7).
 Smith, E. F. — (3); — (7).
 Smith, H. H. 5935 (7); 6013 (2a).
 Smith, L. E. 571 (2a).
 Snyder, J. B. 217 (1a).
 Soper, M. — (2a).
 Spaulding, Rev. —. — (7c).
 Spencer, M. F. 995 (5); 2360 (7c).
 Sprague, R. —, 426 (2); 425 (2a).
 Standley, P. C. 14 (7c); 1070 (5a); 4102 (1a); 5044 (5a); 13989 (3c); 15553 (2); 16845, 17846, 18821 (1).
 Stanfield, S. W. — (6b).
 Steele, E. S. — (3).
 Steele, E. S. & Steele, Mrs. —. 238 (1a).
 Stevens, G. W. 798 (6b); 2105 (6a).
 Stinchfield (Ferris), R. 373 (6b).
 St. John, H. 1439 (7); 2380 (3); 4458 (2).
 St. John, Mrs. O. 42 (1a).
 Straub, —. — (6).
 Sturtevant, E. L. — (1a); — (6).
 Suksdorf, W. — (1a); — (2a); 1522 (5); 4049 (3d); 5133 (2); 5134 (2a); 11414, 11692 (2).
 Sullivant, E. — (1a).
 Suttie, —. — (3a).
 Sykes, Dr. —. — (7b).
 Tatnall, E. — (7).
 Taylor, B. C. — (1a).
 Thone, F. H. 53 (6b); 61 (1a).
 Thornber, J. J. — (7c).
 Throop Herb. — (6a).
 Thurber, G. 222 (3c).
 Tidestrom, I. 9157 (6b); 10255 (2); 10727 (5); 10791 (7c); 11516 (6a).
 Torrey, G. 748 (1a).
 Torrey, J. — (6a).
 Townsend, C. H. T. & Barber, C. M. — (3c); 33 (1a).
 Tracy, S. M. 9449 (6b).
 Tracy, S. M. & Earle, F. S. 288 (7c).
 Treakle, Mrs. A. F. 159 (1).
 Trelease, W. — (1a); 709 (6a); — (6b).
 Tweedy, F. 4640 (2); 3475 (3c).
 Umbach, L. M. 371 (3c).

Underwood, — (7).
 Vasey, G. R. — (7c); 429 (2a); 430 (3c).
 Vesey, L. J. X. de 100 (7c).
 Vestal, A. G. — (3c).
 Victorin, Fr. Marie, 9652 (1a); 15740,
 15741, 15742 (7).
 Victorin, Fr., Brunel, Fr., Rolland, Fr.,
 Germain, Fr. & Rousseau, Fr. 17337
 (7).
 Victorin, Fr. & Germain, Fr. 21988 (1a).
 Viereck, H. L. — (6).
 Vogel, J. — (3c).
 Vorhies, C. T. 44 (5).
 Waghorne, A. C. — (1a).
 Walker, E. P. 191 (7c).
 Ward, L. F. — (6b).
 Ware, R. A. — (1a).
 Watson, S. — (2).
 Watt, G. H. — (5).
 Weatherby, C. A. 4324 (3).
 Webb, R. — (6b).
 Webber, H. J. — (1a); — (6b).
 Wheeler, L. A. — (7); 2 (3).
 White, O. E. — (1a).
 Whited, K. 148 (1); — (5); — (2); 1423
 (3c).
 Wiegand, K. M. 3038 (7); 12760 (6a).
 Wiegand, K. M. & Hentley, M. — (3).
 Williams, E. F. — (1a); — (3); — (6a);
 — (7); — (6b); 1 (1a).
 Williams, E. F., Collins, J. F. & Fernald,
 M. L. — (1a); — (3).
 Williams, E. F. & Fernald, M. L. — (3).
 Williams, T. A. — (1); — (7b).
 Williamson, C. S. — (2); — (3); — (6b);
 1692 (1a).
 Williamson, E. B. — (1a).
 Winslow, E. J. — (3).
 Wislizenus, F. 458 (7c); 496 (3c); 579
 (1a).
 Witham, H. —, 8990 (2).
 Woodson, R. E. Jr. 681, 1660, 1650 (6b);
 1651 (1a); 1655, 1656, 1672, 1676,
 1679, 1682 (6); 1686 (7); 1698 (6b);
 1713, 1714 (1a); 1719, 1729 (6a); 1730
 (6); 1740 (7b); 1746 (6); 1745, 1747,
 1748 (6b); 1809 (3c); 1822 (1a); 1917
 (1); 1926 (6a); 2703 (6); 29162 (7).
 Woodson, R. E. Jr., & Anderson, E.
 1541 (6a); 1548 (6b); 1549 (6a); 1551
 (6); 1608 (6a); 1701 (6); 5205 (7c);
 28988 (7); 29001 (3d); 29002 (1a);
 29007 (3d); 29075 (5); 29089 (1a);
 29100, 29109 (7c); 29112 (1a); 29120
 (1); 29123 (1a).
 Woodson, R. E. Jr., & Barnhart, F. C.
 29028 (3d); 29029 (7c); 29030 (3c);
 29032 (1b).
 Woodson, R. E. Jr. & Fuller, H. J.
 1653, 1696 (3b).
 Wooton, E. O. — (1); — (1a); — (7c);
 113 (3c).
 Wooton, E. O. & Standley, P. C. 3451
 (3).
 Wright, A. H. —, 12759 (7).
 Wright, A. H. & Griscom, L. 10620 (6b).
 Wright, W. F. 229 (1a).
 Wurtson, J. B. — (1).
 Yates, H. — (2).
 Young, —. — (7).
 Zeller, S. M. — (2a).
 Zeller, S. M. & Zeller, E. B. 1187 (1a).

III. TRACHOMITUM: A NEW GENUS OF APOCYNOIDEAE

In their 'Revisione Monografica del Genere *Apocynum* Linn.', Béguinot and Belosersky treat the Eurasian species and varieties of the Linnean genus *Apocynum* as representing a section analogous to their sections *Androsaemifolii*, *Cannabini*, *Hypericifolii*, and *Medii*, which, as we have already shown, are so confluent and vague that they do not merit the distinction of denomination. In founding their section *Veneti* to accommodate the Eurasian

representatives of the genus related to *Apocynum venetum* L., those authors epitomize it as follows:⁹⁸

"It is characterized by the elliptical-oblong foliage, narrow or broad, short or elongate, of delicate or somewhat coriaceous texture, minutely but distinctly denticulate, always incised along the margin with minute denticles, and otherwise glabrous: by the cylindrical-campanulate corolla, of medium size, and a trifle nodding."

To judge merely from the analysis quoted above in direct translation from the Italian of Béguinot and Belosersky, the Eurasian species and varieties of the Linnaean genus *Apocynum* are separable from the North American species and varieties only by the foliage. Actually, however, those two elements are so distinct in their floral organs and inflorescence that they are deemed to merit generic distinction. For reasons which have been advanced in the preceding section concerning the emended genus *Apocynum*, the North American element has been shown to be the typical and traditional element of the genus. Therefore the Eurasian element, represented in the Linnaean genus *Apocynum* by *A. venetum* L. is proposed as a new genus.

Trachomitum,⁹⁹ n. gen. of the Apocynaceae.

Herbaceous lactescent perennials from somewhat thickened fibrous rhizomes. Stems erect or ascending, cylindrical, striate, glabrous; branches ascending, subalternate. Leaves opposite, or occasionally subopposite, petiolate, oblong-ovate to linear-lanceolate, membranaceous, coriaceous-denticulate along the margins, and frequently also along the midrib of the lower surface, mucro-

⁹⁸ Bég. & Bel. Atti R. Accad. Lincei, V. 9: 67. 1913. "È caratterizzata per le foglie ellittico-oblungh, strette o larghe, corte od allungate, a tessitura debole od anche un po' coriacee, brevemente ma distintamente picciolate, sempre incise ai margini da minimi dentini, e nel resto glabre: per la corolla cilindrico-campanulata, mediocre, a lobi rotondati, ed un po' curvati in fuori."

⁹⁹ *Trachomitum* Woodson, gen. nov. Apocynacearum. Calyx 5-partitus hispidulus, disco non adnatus, eglandulosus. Corolla cylindrica granulo-papillata, limbo 5-partito aestivatione dextrorum contorta, squamellis 5 coalescens in tubo corollae insertis. Stamina 5 tubo corollae affixa inclusa cum corollae sequentia alternatis, filamentis brevibus ellipsoideo-cylindricis, antheris sagittatis basi cum auriculis vergentibus instructis. Ovarium bilobum, lobis singularibus unilocularibus, ovulis in quoque loculo binis superpositis. Nectaria 5 integra supra discum propriam intra tubum calycis immersum. Follicula teretes recti vel falcati.—Herba perennis e rhizomate horizontali erecta ramosa, ramis ascendentibus plerisque alternis. Folia opposta petiolata membranaceae coriaceo-denticulatae penninervia. Cymae pedunculatae terminales plus minusve compositae hispidulosa.

nate, pinninerved; petioles bearing 2-4 small, attenuate, pectinate glands at the base. Inflorescence a terminal pedunculate bracteate hispidulous monochasial cyme. Calyx regularly 5-parted, hispidulous, the tube adherent but not adnate to the receptacle, eglandular within. Corolla cylindrical to cylindrical-campanulate, regularly 5-parted, very conspicuously granulose-papillate, bearing within 5 apiculate appendages coalesced into a ring and adnate to the base of the tube, the apices opposite the lobes of the corolla-limb; limb erect or spreading, dextrorsely convolute in the bud. Stamens 5, alternate with the apiculi of the appendicular ring and attached to the base of the corolla-tube, convergent about the pistil; anthers of two small unilocular sporangia borne ventrally near the apex of an enlarged sagittate, auriculate, peltately stipitate connective; auricles of the anther-connective convergent, with a closed sinus; filament short, flattened; pollen borne in tetrads, mostly sterile. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal binate stigma; ovules many, anatropous, borne upon a ventral, lateral, binate placenta. Receptacle somewhat elevated above the orifice of the calyx-tube, variously lobed, scarcely entire; nectaries 5, separate, ovate-cylindrical, situated upon the receptacle in a ring about the carpels. Follicles 2, divaricate, terete, somewhat falcate, pendulous, containing many dry, apically comose, terete, exaluminous seeds; embryo straight.

Type species: *Trachomitum venetum* (L.) Woodson.

KEY TO THE SPECIES

- a. Corolla cylindrical-campanulate, the tube dilating conspicuously, corolla-lobes equaling, or nearly equaling the length of the tube; calyx-lobes oblong-lanceolate; inflorescence relatively few-flowered and dense.
 - b. Leaves relatively large, 3-5.5 cm. long.
 - c. Leaves lanceolate to oblong-lanceolate.....1. *T. venetum*
 - cc. Leaves ovate to oblong-ovate.....1a. *T. venetum* var. *ellipticifolium*
 - bb. Leaves relatively small, 1-1.5 cm. long.....1b. *T. venetum* var. *microphyllum*
- aa. Corolla cylindrical, the tube not dilating; corolla-lobes about one-third the length of the tube; calyx-lobes ovate-deltoid; inflorescence many-flowered and loose.....2. *T. sarmatiense*

1. *Trachomitum venetum* (L.) Woodson, n. comb.

Apocynum venetum L. Sp. Pl. ed. 1, 213. 1753; Sibth. Fl. Graec. 1: 166. 1806; Roem. & Schult. Syst. 4: 405. 1818; Rchb.

Fl. Lid. Ven. 68. 1818; Biebers. Fl. Taur.-Cauc. 3: 173. 1819; Moric. Fl. Ven. 1: 128. 1820; Roehl. Mert. & Koch, Deutschl. Fl. 2: 291. 1824; Nacc. Fl. Ven. 2: 52. 1827; Host, Fl. Austr. 1: 315. 1827; Reichenb. Ic. Fl. Germ. & Helv. 2: 429. 1831; Bert. Fl. Ital. 3: 16. 1837; A. DC. in DC. Prodr. 8: 440. 1844; Ledeb. Fl. Ross. 3: 43. 1846; Boiss. & Buhse, Pl. Pers. 147. 1860; Boiss. Fl. Or. 48. 1879; Hook. Fl. Br. Ind. 4: 657. 1882; Parl. Fl. Ital. 6: 713. 1884; Aitch. Bot. Afghan. Delim. Comm. 87. 1887; Archangeli, Comp. Fl. Ital. 364. 1894; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4²: 179. 1895; Fiori & Paoletti, Fl. Anal. Ital. 2: 343. 1900; Kusn., Busch & Fomin, Fl. Cauc. 4¹: 428. 1903; Krylof, Fl. Alt. 3: 827. 1904; Bég. & Bel. Atti R. Accad. Lincei V. 9: 69. 1913; Fiori, Nuova Fl. Anal. Ital. 2: 245. 1926.

Asclepias rubra Sievers in Pall. Fl. Nord. Beitr. 7: 329. 1771.

Apocynum syriacum Gmel. Reise Russ. 2: 198. 1774, *non* Clus.

Apocynum androsaemifolium Forsk. Fl. Aeg.-Araò. 22. 1775, *non* L.

Nerium sibiricum Medic. Beobacht. 15. 1782.

Apocynum compressum Moench, Meth. 464. 1794.

Nerium antidysentericum Lepech. Reise 1: 270. 1800.

Apocynum sibiricum Pall. ex R. Br. Mem. Wern. Soc. 1: 68. 1809, *non* Jacq.; Roem. & Schult. Syst. 4: 405. 1818; Ledeb. Fl. Alt. 1: 235. 1829; Bongd. & Meyer, Suppl. Fl. Alt. 181. 1841; Karel. & Karil. Enum. Pl. Soong. 542. 1842.

Apocynum venetum L. var. *latifolium* Rchb. Ic. Fl. Germ. & Helv. 17: 16. t. 24. 1855; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 71. 1913.

Apocynum venetum L. var. *typicum* Bég. & Bel. l. c. 69. 1913.

Apocynum venetum L. var. *oblongifolium* Bég. & Bel. l. c. 71. 1913.

Apocynum venetum L. var. *longifolium* Bég. & Bel. l. c. 1913.

Apocynum venetum L. var. *wolgense* Fischer ex Bég. & Bel. l. c. 72. 1913. *nomen*.

Apocynum venetum L. var. *anomalum* Bég. & Bel. l. c. 76. 1913.

Apocynum venetum L. var. *turkestanicum* Bég. & Bel. l. c. 76. 1913.

Apocynum venetum L. var. *scabrum* Bég. & Bel. l. c. 1913.

Apocynum venetum L. var. *brachycarpum* Bég. & Bel. l. c. 77. 1913.

Stems erect or ascending, 3-10 dm. tall, glabrous, freely branched; branches subalternate, ascending; leaves opposite or subopposite, petiolate, lanceolate, acute to obtuse at the base, acuminate to acute at the apex, glabrous, denticulate, membranaceous, mucronate or without a mucro; inflorescence relatively few-flowered, bracts conspicuous, persistent, frequently semifoliaceous; corolla cylindrical-campanulate, the tube 4-5 mm. long, 3-5 mm. broad, dilating toward the orifice, the lobes oblong to oblong-lanceolate, equaling or nearly equaling the length of the tube, spreading; calyx-lobes hispidulous, lanceolate to oblong-lanceolate, 2-2.5 mm. long; follicles terete, 5-10 cm. long, somewhat falcate, pendulous.

Distribution: sparingly upon the shores of the Adriatic, Aegean, and Black Seas in Europe; generally throughout central Persia, Turkestan, India, and China, to the shores of the Yellow Sea. Largely plants of maritime and alkaline situations.

Specimens examined:

ITALY: "in arenosis maritimis propre Venetias," July, 1880, *Penzig* 1169 (G); Venetia, July 10, 1908, *Fiori & Beguinot* 1109 (G); "ex maritimis Venetis, al Lido," June 22, 1868, *Ball* (G, MBG, NY); sand-dunes, Lido, Venice, May 25, 1906, *Pease* 9213 (G); Lido, Venice, July 21, 1878, *Martens* (G); "in collibus arenosis ad litus maris Adriatici propre Grado," date lacking, *Pichler* 188 (G); Sicily, June, 1871, *Gandoger* 1661 (MBG, US); Aquileia, date lacking, *Bernhardi* *Herb.* (MBG); "Monfalcone ad litus maris," June, year lacking, *Lagger* (MBG); shores of the Adriatic Sea near Monfalcone, June 25, 1867, *Ascherson* (MBG); Venice, date lacking, *Burkhardt* (ANS); Lido, Venice, 1840, *Kettner* (NY); Trieste, June, 1868, *Prihler* (US); seashore, Monfalcone, June 25, 1882, *Kammerer* (US); Venice, Spiaggia di Alberone, July, 1910, *Vaccari* (US); Trieste, June 11, 1895, *Engelhardt* (US).

RUSSIA: Uralsk, date lacking, *Burmeister* (US, ANSP, NY); Lakon, Turkestan, Aug. 22, 1879, *Nervessky* (NY, US); Lepsinsk, July 25, 1891, *Timsfegen* (US); Turkestan, exact locality lacking.

June 3, 1884, *Regel* (NY); Kiufer, Turkestan, May 30, 1877, *Regel* (ANSP); Kakiansu, Turkestan, Aug. 24, 1878, *Regel* (NY); "southern Russia," exact locality and date lacking, *Fischer* 84 (NY); Lenkoran and Kisilagatsch, July 8, 1838, *Hohenacker* (US).

TURKEY: Anatolia, exact locality and date lacking, *Wiedemann* (US); Smyrna, 1890, *Ball* (G); Amadia, Aug. 13, 1841, *Hohenacker* (G); exact locality lacking, July-Aug. 1841, *Grout & Hemslall* (NY).

PERSIA: Szovis, *Herb. Hort. Petrop.* (G); Teheran, June 24, 1843, *Hohenacker* 397 (MBG).

CHINA: "Songaria ad lacum Saisang-Nor," *Herb. Acad. Petrop.* (G); Chefoo, 1883, *Perry* (G); Ajagus, Soongaria, 1867, *Schrenk* (NY); Chu Kou, Shansi, June 30, 1925, *Ling* 9114 (US); Dschues-Ahatsch, Soongaria, 1841, *Karelin & Kirilloff* (NY); environs of Pekin, date lacking, *David* (ANSP).

1a. *Trachomitum venetum* (L.) Woodson var. *ellipticifolium* (Bég. & Bel.) Woodson, n. comb.

Apocynum venetum L. var. *ellipticifolium* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 75. 1913.

Leaves ovate to ovate-oblong, rounded or retuse at the apex, not mucronate.

Distribution: southern Russia to central China.

Specimens examined:

RUSSIA: "Rossia meridionalis," date lacking, *Bongard* (G).

AFGHANISTAN: exact locality lacking, 1884-85, *Aitchison* 115 (G).

1b. *Trachomitum venetum* (L.) Woodson var. *microphyllum* (Bég. & Bel.) Woodson, n. comb.

Apocynum venetum L. var. *microphyllum* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 76. 1913.

Leaves ovate-oblong to oblong-lanceolate, 1-1.5 cm. long, mucronate.

Distribution: east-central China.

Specimens examined:

CHINA: Chin Yuan Hsien, Shansi, Aug. 10, 1925, *Ling* 9582 (US).

2. *Trachomitum sarmatiense*¹⁰⁰ Woodson, n. sp.

Stems erect or ascending, 8-12 dm. tall, glabrous, freely branched; branches subalternate, ascending; leaves opposite, petiolate, oblong-ovate, obtuse or rounded at the apex, truncate to subtruncate at the base, glabrous and more or less glaucous beneath, irregularly and remotely denticulate, membranaceous, mucronate; inflorescence very loose and extensive, bracts inconspicuous, deciduous, never semifoliaceous; corolla cylindrical, the tube 2.5-3.5 mm. long, 2-3.5 mm. broad, not dilating, the lobes .75-1.0 mm. long, ovate-oblong, erect, not spreading; calyx-lobes hispidulous, ovate-deltoid, .75-1.0 mm. long; follicles unknown.

Distribution: known only from southeastern Russia.

Specimens examined:

RUSSIA: "E. Rossia meridion," date lacking, *Herb. Acad. Petrop.* (G).

Summarized, the relationship of the genus *Trachomitum* to the other genera of the subfamily Apocynaceae may be expressed as follows:

APOCYNUM	TRACHOMITUM	POACYNUM
<i>Genus</i> of North America.	<i>Genus</i> of Eurasia.	<i>Genus</i> of Eurasia.
<i>Inflorescence</i> a trichasium, terminal or axillary.	<i>Inflorescence</i> a monochasium, terminal; pedicels solitary.	<i>Inflorescence</i> a monochasium, terminal; pedicels paired.
<i>Corolla</i> campanulate to cylindrical, glabrous.	<i>Corolla</i> cylindrical to cylindrical-campanulate, granulo-papillate without.	<i>Corolla</i> pelviform, granulo-papillate without.
<i>Corollar appendages</i> distinct.	<i>Corollar appendages</i> coalesced into a broad ring, apices short.	<i>Corollar appendages</i> coalesced into a shallow ring, apices elongate.
<i>Anther auricles</i> parallel	<i>Anther auricles</i> convergent.	<i>Anther auricles</i> overlapping.

¹⁰⁰ *Trachomitum sarmatiense* Woodson, sp. nov., perenne; caule erecto vel ascendente ramoso striato omnino glabro; foliis oppositis petiolatis membranaceis oblongo-ovatis remote irregularisque coriaceo-denticulatis mucronatis; petiolis 3-5 mm. longis; calycis lobis hispidulis ovatis ca. 1 mm. longis; corolla cylindrica granulato-puberulenta, tubo ca. 3 mm. longo, limbo 5-partito, ca. 3. mm. lato; folliculis ignotis.—Type collected in "E. Rossia meridion," date lacking, collector unknown (G, distributed from *Herb. Acad. Petrop.*).

<i>Stigmata</i> blunt.	<i>Stigmata</i> blunt.	<i>Stigmata</i> apiculate.
<i>Nectaries</i> distinct.	<i>Nectaries</i> distinct.	<i>Nectaries</i> more or less coalesced into a ring.
<i>Receptacle</i> totally immersed, entire.	<i>Receptacle</i> somewhat elevated above the orifice of the calyx-tube, somewhat lobed.	<i>Receptacle</i> somewhat elevated above the orifice of the calyx-tube, entire.
<i>Calyx-tube</i> adnate to the receptacle.	<i>Calyx-tube</i> adherent, but not adnate, to the receptacle.	<i>Calyx-tube</i> adnate to the receptacle.
<i>Leaves</i> opposite, the margins entire.	<i>Leaves</i> opposite, the margins denticulate.	<i>Leaves</i> alternate, the margins denticulate.
<i>Petioles</i> subtended by attenuate gland-like appendages.	<i>Petioles</i> subtended by attenuate gland-like appendages.	<i>Petioles</i> unappendaged or subtended by a pair of punctate glands.

As summarized on pages 162-163, it is considered that evolution in the tribe Apocynaceae has probably progressed from a primitive condition represented by *Apocynum*, through a condition represented at present by *Trachomitum*, to the relatively advanced condition of the genus *Poacynum*. This attitude is taken from a consideration of the inflorescence, the corolline appendages, the nectaries, the receptacle, and the petiolar appendages, as indicated on pages 162-163. The geographical distribution of the three genera would further substantiate such a viewpoint, since the genus *Apocynum* occupies geologically older territory than the genera *Trachomitum* and *Poacynum*, which are almost entirely restricted to the Tertiary sea troughs of southern Europe and south-central Asia.

ABBREVIATIONS

In the preceding taxonomic treatment of the genus *Trachomitum*, the various herbaria in which specimens have been examined are noted as follows:

MBG = Herbarium of the Missouri Botanical Garden.
 G = Gray Herbarium of Harvard University.
 NY = Herbarium of the New York Botanical Garden.
 US = United States National Herbarium.
 F = Herbarium of the Field Museum of Natural History.
 ANSP = Herbarium of the Academy of Natural Sciences of Philadelphia.

LIST OF EXSICCATAE

The distribution numbers are printed in *italics*. Unnumbered collections are indicated by a dash. The numbers in parentheses are the species numbers used in this monograph.

Aitchison, J. E. T. <i>115</i> (1a).	Karelin, —. & Kirilloff, —. — (1).
Ascherson, P. — (1).	Kettner, —. — (1).
Ball, J. — (1).	Lagger, —. — (1).
Bernhardi Herb. — (1).	Ling, K. <i>9114</i> (1); <i>9582</i> (1b).
Bongard, G. H. — (1a).	Martens, F. W. — (1).
Burkhardt, —. — (1).	Nervesky, —. — (1).
Burmeister, —. — (1).	Pease, A. S. <i>9213</i> (1).
David, A. — (1).	Penzig, O. <i>1169</i> (1).
Engelhardt, V. — (1).	Perry, W. — (1).
Fiori, A. & Béguinot, A. <i>1109</i> (1).	Pichler, —. <i>188</i> (1).
Fischer, —. <i>84</i> (1).	Prihler, Th. — (1).
Gandoger, M. <i>1661</i> (1).	Regel, A. — (1).
Grout, Dr. —. & Hemsdall, Rev. —. — (1).	Schrenk, —. — (1).
Herb. Acad. Petrop. — (1); — (2).	Timsegen, —. — (1).
Hohenacker, R. F. —, <i>397</i> (1).	Vaccari, A. — (1).
Kammerer, P. — (1).	Wiedemann, —. — (1).

IV. A REVISION OF THE GENUS *POACYNUM*

The genus *Poacynum* was segregated from *Apocynum* by Baillon¹⁰¹ in 1888, who based it upon *Apocynum pictum* Schrenk. The only distinctive characters which were recorded by Baillon were the alternate leaves and the pelviform corolla, hence the genus has been widely misunderstood.

Baillon¹⁰² remained convinced of the validity of his genus *Poacynum* in subsequent works, as was also Schumann,¹⁰³ who organized the Apocynaceae for Engler & Prantl's 'Die natürlichen Pflanzenfamilien.' However, Danguy,¹⁰⁴ and Béguinot and Belosersky¹⁰⁵ are of a different opinion, and consider *Poacynum* as representing merely an element of the Linnaean genus *Apocynum*. Danguy, while considering *Poacynum* as congeneric with *Apocynum*, recognized that the former genus differs from the latter by

¹⁰¹ Baill. Bull. Soc. Linn. Paris 1: 757. 1888.

¹⁰² Ibid. Hist. Pl. 10: 208. 1891.

¹⁰³ K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4¹: 179. 1895.

¹⁰⁴ P. Danguy in Lecomte, Not. Syst. 2: 135. 1911.

¹⁰⁵ Bég. & Bel. Atti R. Accad. Lincei, V. 9: 77. 1913.

such important characters as the alternate leaves, the pelviform corolla, and an annular "disc," thus representing a most unusual element in the latter genus. Béguinot and Belosersky, however, reduced *Poacynum* to a section, *Picti*, of *Apocynum*, with the following diagnosis:¹⁰ ". . . sparse foliage, gradually attenuate to a point, coriaceous, of a glaucous greenish color, with nerves more or less visible, . . . pelviform corolla, and . . . pendulous flowers."

Several morphological reasons (cf. pp. 162-163) have already been given in a previous section of this study in an attempt to justify the retention of *Poacynum* as a genus of the subfamily Apocynoideae.

For a personal knowledge of the genus *Poacynum*, which is extremely rare in continental herbaria, and which was entirely absent from American collections until the present studies were undertaken, the author is indebted to M. P. Danguy of the Herbarium of the Museum of Paris for fragments of the type specimen of *P. grandiflorum* Danguy, to Mr. Alfred Rehder of the Arnold Arboretum of Harvard University for a fragment of the type specimen of *Apocynum Hendersonii* and a photograph of *Poacynum pictum* (Schrenk) Baill. which he obtained from the Jardin Principal Botanique de Petrograd through the kindness of Prof. Boris Fedtschenko, and to Dr. Carl C. Epling for a fragment of an authentic specimen of *Apocynum Hendersonii*.

Poacynum Baill. Bull. Soc. Linn. Paris 1: 757. 1888; Hist. Pl. 11: 208. 1891; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4: 179. 1895.

Apocynum § *Picti* Bég. & Bel. Atti R. Accad. Lincei, V. 9: 77. 1913.

Herbaceous lactescent perennials from a somewhat thickened fibrous rhizome. Stems erect or ascending, terete, striate, glabrous; branches ascending, alternate to subalternate; leaves

¹⁰ Bég. & Bel. Atti R. Accad. Lincei, V. 9: 77. 1913. "Comprende [Stirps A. *Picti*] due specie confinante nell' Asia centrale: e, cioè, *A. pictum* della Songaria, ed *A. Hendersonii*, pure di questo paese, non che del Turkestan cinese e del Kan-sou mongolico. Ambedue convengono per alcuni caratteri di stirpe, quali le foglie sparse, insensibilmente attenuate in picciuolo, coriacee, di un colore verde-glaucio, con nervi poco o punto visibili, per la corolla più grande, pelviforme e per i fiori penduli."

alternate, petiolate, oblong to lanceolate, membranaceous, remotely denticulate along the margin, and frequently also along the midrib of the lower surface, mucronate, or without a mucro, penninerved; petioles subtended by two punctate glands or eglandular. Inflorescence a terminal monochasium, bearing paired pedicels. Calyx regularly 5-parted, hispidulous, the tube adnate to the receptacle, eglandular within. Corolla pelviform, regularly 5-parted, conspicuously granulo-papillate without, bearing within 5 elongate-apiculate appendages coalesced into a shallow ring adnate to the base of the tube, the apices opposite the lobes of the corolla; limb widely spreading, dextrorsely convolute in the bud. Stamens 5, alternate with the apices of the appendicular ring and attached to the base of the corolla-tube, anthers appendaged, convergent about the pistil; filaments short, flattened; pollen borne in tetrads, mostly sterile. Carpels 2, unilocular, sessile, united at the apices by an ovate-cylindrical clavuncle bearing the terminal binate apiculate stigma; ovules many, anatropous, borne upon a ventral, lateral placenta. Receptacle somewhat elevated above the orifice of the calyx-tube, entire; nectaries 5, more or less coalesced into a ring about the gynoecium. Follicles terete, pendulous, 15-30 cm. long, divaricate or somewhat falcate, containing many dry, apically comose, clavate-terete, exaluminous seeds; embryo straight.

Type species: *Poacynum pictum* (Schrenk) Baill. Bull. Soc. Linn. Paris 1: 757. 1888.

KEY TO THE SPECIES

- a. Calyx-lobes ovate; leaves linear..... 1. *Poacynum pictum*
- aa. Calyx-lobes lanceolate; leaves lanceolate to oblong-ovate.
 - b. Leaves cuneate-lanceolate, decidedly mucronate; nectaries evident, about $\frac{3}{4}$ the length of the carpels..... 2. *Poacynum grandiflorum*
 - bb. Leaves oblong-lanceolate to oblong-ovate, neither cuneate nor mucronate; nectaries inevident, about $\frac{1}{2}$ the length of the carpels..... 2. *Poacynum Hendersonii*

1. *Poacynum pictum* (Schrenk) Baill. Bull. Soc. Linn. Paris 1: 757. 1888; Hist. Pl. 10: 208. 1891; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. 4¹: 179. 1895.

Apocynum pictum Schrenk, Bull. Acad. St. Petersb. 2: 115. 1844; Bég. & Bel. Atti R. Accad. Lincei, V. 9: 77. 1913.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate to subalternate, ascending; leaves petiolate or subsessile, linear or very narrowly lanceolate, acute to acuminate at base and apex, membranaceous, glabrous, denticulate, mucronate; inflorescence few-flowered, bracts evident, scarious; corolla pelviform, granulo-papillate, about 1–1.5 cm. broad; calyx-lobes ovate, about 3–5 mm. long, hispidulous; follicles unknown.

Distribution: Songaria.

Specimens examined:

SONGARIA: "in deserto songoro-kirghisico ad m. Tamgaly-Tas," Schrenk (L, TYPE, MBG photograph).

2. *Poacynum grandiflorum* P. Danguy in Lecomte, Not. Syst. 2: 136. 1911.

Apocynum grandiflorum P. Danguy in Lecomte, l. c. 137. 1911.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate, ascending; leaves petiolate, cuneate-lanceolate, 3–5 cm. long, 1–1.5 cm. broad, remotely denticulate, decidedly mucronate, membranaceous; inflorescence relatively few-flowered; corolla pelviform, 1.5–2 cm. broad, granulo-papillate; calyx-lobes lanceolate, about 2 mm. long, hispidulous; nectaries evident, about two-thirds the length of the carpels; follicles terete, pendulous, 1.5–3 cm. long; seeds clavate, 3–4 mm. long, coma 15–20 mm. long.

Distribution: Turkestan.

Specimens examined:

TURKESTAN: Cha-yar, prov. of Chouchar, May, 1907, *Vaillant* 266 (MP TYPE, MBG fragment).

3. *Poacynum Hendersonii* (Hook. f.) Woodson, n. comb.

Apocynum Hendersonii Hook. f. in Henderson & Hume, Lahore to Yarkand, 327. 1878, Bég. & Bel. Atti R. Accad. Lincei, V. 9: 78. 1913.

Stems erect or ascending, 5–10 dm. tall, glabrous, freely branched; branches alternate, ascending; leaves petiolate, oblong-lanceolate to oblong-ovate, 3–5 cm. long, 1–2 cm. broad, neither cuneate nor mucronate; inflorescence relatively many-flowered;

corolla pelviform, granulo-papillate, 1.5-2 cm. broad; calyx-lobes lanceolate, about 3 mm. long; nectaries inevident, about one-third the length of the carpels; follicles unknown.

Distribution: Turkestan and Songaria.

Specimens examined:

TURKESTAN: Kashgar, alt. 4000 ft., date lacking, Creswell (BM, MBG, fragment); Yarkand, sandy desert, alt. 4000 ft., May 20, 1874, Henderson & Hume (L, MBG fragment).

ABBREVIATIONS

BM	= Herbarium of the British Museum
L	= Herbarium of the Jardin Principal de Leningrad
MBG	= Herbarium of the Missouri Botanical Garden
MP	= Herbarium of the Museum of Paris

V. INDEX TO SPECIES

New genera, species, varieties, and combinations are printed in **bold face** type; synonyms in *italics*; and previously published names in ordinary type.

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<i>Apocynum</i>	83	var. <i>nevadense</i>	102
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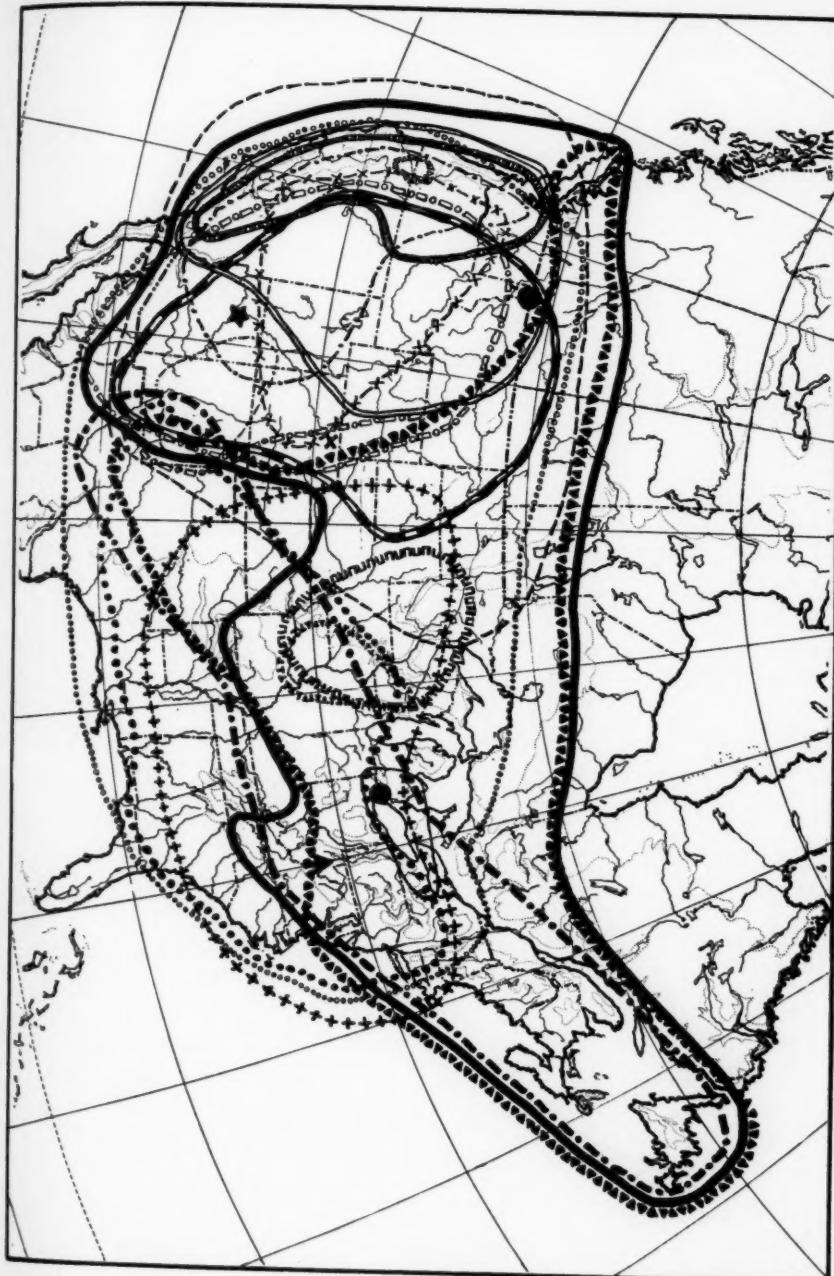
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EXPLANATION OF PLATE

PLATE 1

Geographical distribution of the genus *Apocynum*.

- A. *androsaemifolium*.
- A. *androsaemifolium* var. *incanum*.
- X A. *androsaemifolium* var. *intermedium*.
- A. *pumilum*.
- A. *pumilum* var. *rhomboideum*.
- A. *medium*.
- TATAT A. *medium* var. *leuconeuron*.
- A. *medium* var. *floribundum*.
- A. *medium* var. *sarniense*.
- A. *medium* var. *lividum*.
- ΔΔΔΔ A. *medium* var. *vestitum*.
- ★ A. *Jonesii*.
- A. *Sukedorfii*.
- A. *Sukedorfii* var. *angustifolium*.
- A. *cannabinum*.
- ++ A. *cannabinum* var. *pubescens*.
- oooo A. *cannabinum* var. *glaberrimum*.
- ▲ A. *cannabinum* var. *Greeneanum*.
- VATAT A. *cannabinum* var. *hypericifolium*.
- A. *cannabinum* var. *Farwellii*.
- A. *cannabinum* var. *cordigerum*.
- A. *cannabinum* var. *salignum*.



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EXPLANATION OF PLATE

PLATE 2

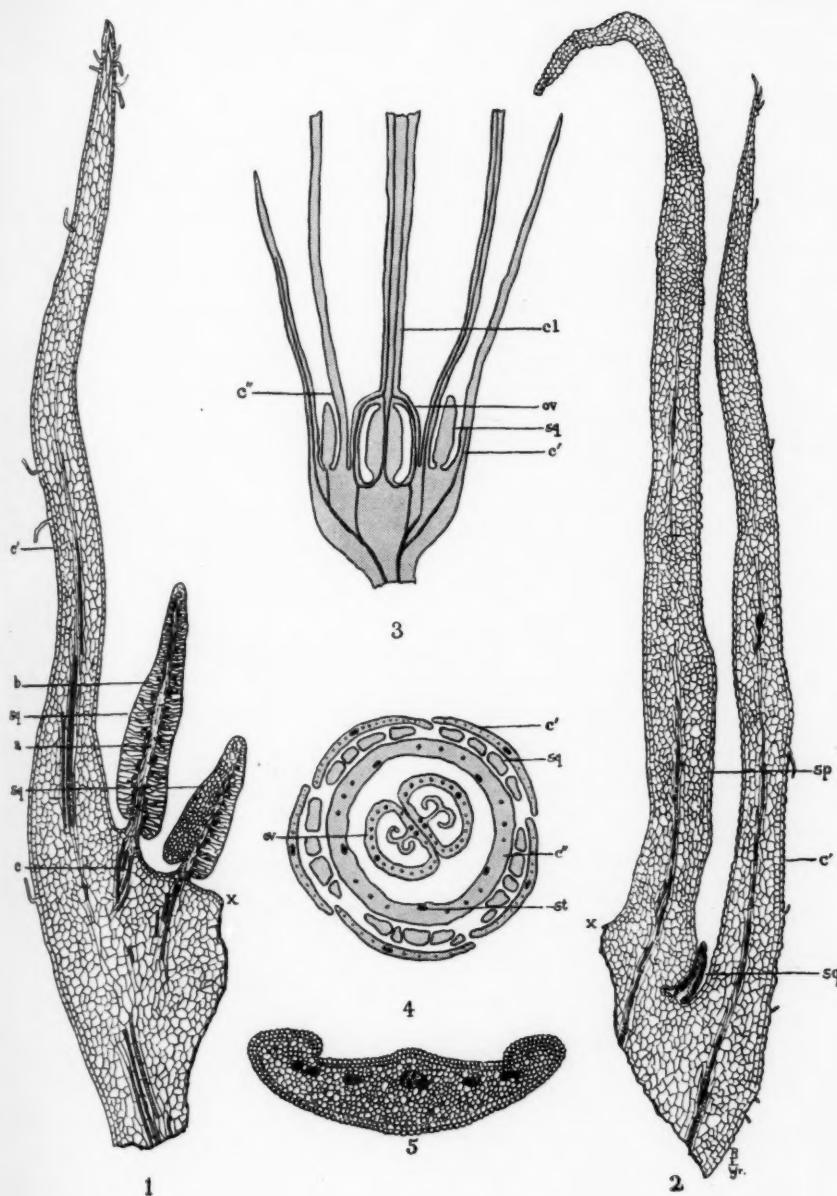
Fig. 1. Longitudinal section of calyx-lobe of single-flowered form of *Nerium Oleander*: *x*, place of attachment to the receptacle; *c'*, calyx-lobe proper; *sq*, calycine squamellae; *b*, peripheral glandular tissue; *a*, central "conductive" tissue; *c*, occasional vascular traces leading to squamellae. $\times 20$.

Fig. 2. Longitudinal section of calyx-lobe and supernumerary petal of double-flowered form of *Nerium Oleander*: *x*, place of attachment to the receptacle; *sp*, supernumerary petal; *c'*, calyx-lobe proper; *sq*, squamella. $\times 20$.

Fig. 3. Diagram of a median longitudinal section of single-flowered form of *Nerium Oleander* illustrating the vascular anatomy: *c'*, calyx; *c''*, corolla; *ov*, ovary; *cl*, clavuncle; *sq*, squamellae.

Fig. 4. Diagram of a cross-section of single-flowered form of *Nerium Oleander*: *c'*, calyx-lobes; *c''*, corolla; *ov*, ovary; *sq*, squamellae; *st*, staminal traces.

Fig. 5. Cross-section of a supernumerary petal of double-flowered form of *Nerium Oleander*. $\times 20$.





EXPLANATION OF PLATE

PLATE 3

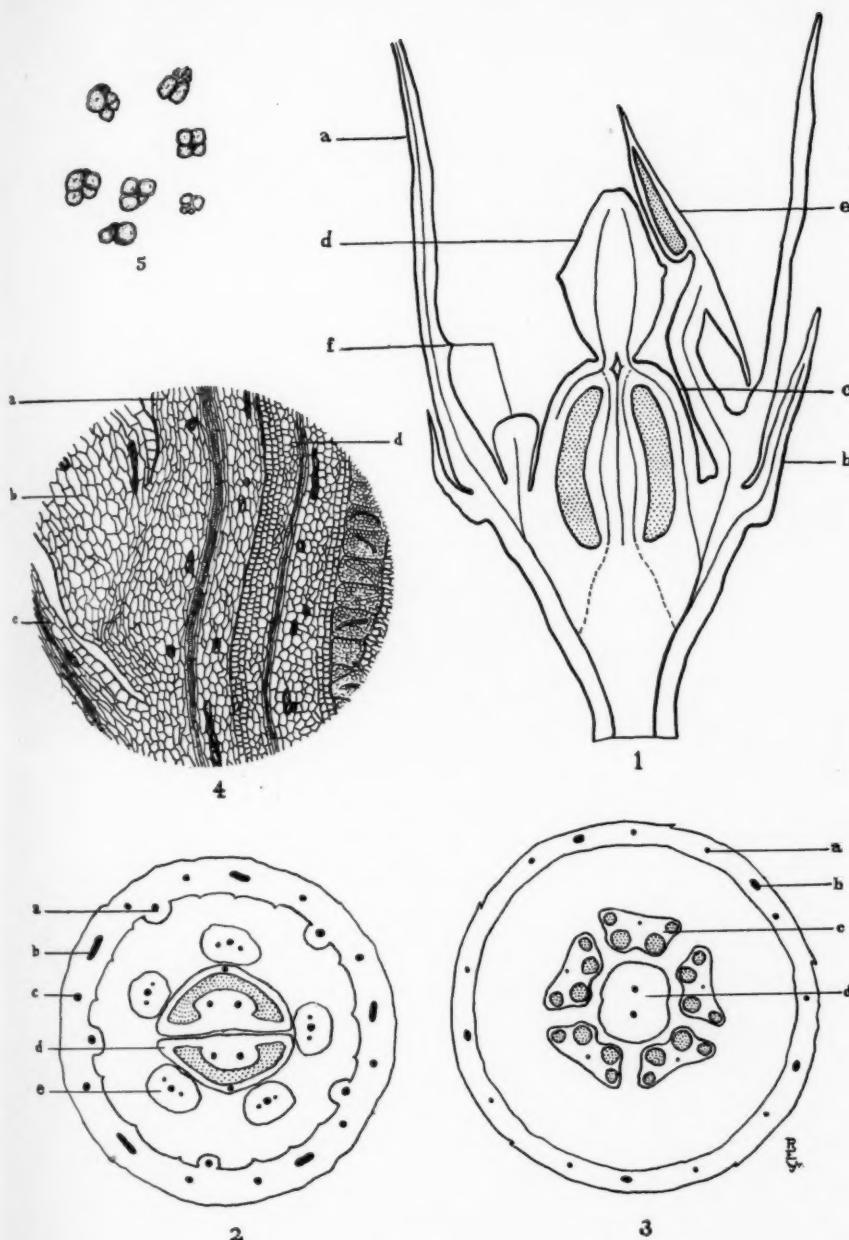
Fig. 1. Diagrammatic longitudinal section of flower of *Apocynum androsaemifolium*, indicating the vascular anatomy: *a*, corolla; *b*, calyx; *c*, ovary; *d*, clavuncle; *e*, stamen; *f*, nectary.

Fig. 2. Diagrammatic cross-section of flower of *Apocynum androsaemifolium* through the region of the gynoecium, indicating the vascular anatomy: *a*, adnate staminal filaments; *b*, dorsal corolline traces, *c*, ventral corolline traces; *d*, ovary; *e*, nectaries.

Fig. 3. Diagrammatic cross-section of flower of *Apocynum androsaemifolium* through the region of the androecium, indicating the vascular anatomy: *a*, ventral corolline traces; *b*, dorsal corolline traces; *c*, anther; *d*, clavuncle.

Fig. 4. Longitudinal section through the place of attachment of the staminal filament to the base of the corolla-tube of *Apocynum androsaemifolium*: *a*, staminal filament; *b*, corolla; *c*, calyx-lobe; *d*, ovary-wall. $\times 150$.

Fig. 5. Pollen grains of *Apocynum medium* var. *leuconeuron*, illustrating sterility and polypory.



EXPLANATION OF PLATE

PLATE 4

Fig. 1. Cross-section of young root of *Apocynum hypericifolium*: *a*, epidermis; *b*, cortex; *c*, endodermis; *d*, xylem; *e*, phloem; *f*, pericycle. $\times 150$.

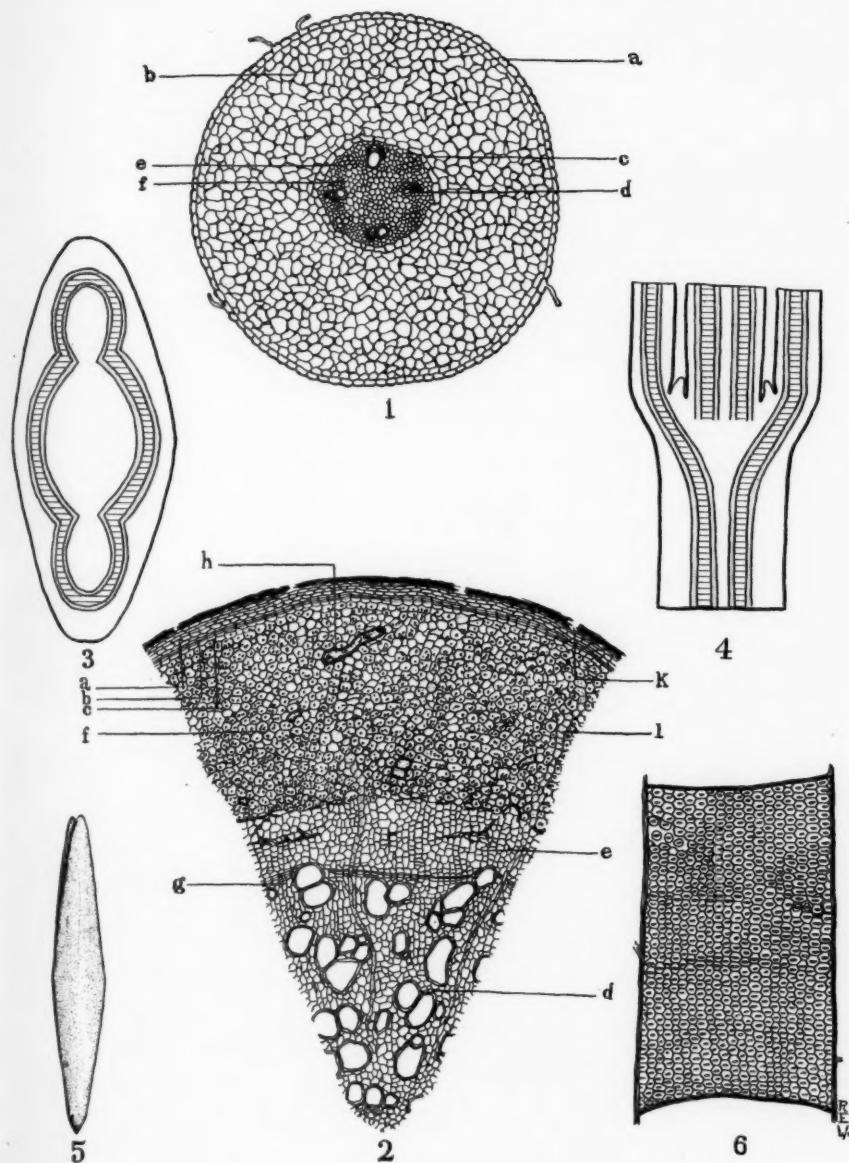
Fig. 2. Cross-section of gemmiferous root of *Apocynum cannabinum* var. *glaberrimum*: *a*, phellem; *b*, phellogen; *c*, pheloderm; *d*, xylem; *e*, phloem; *f*, cortex; *g*, cambium; *h*, latex tube; *k*, lenticel; *l*, storage ray. $\times 150$.

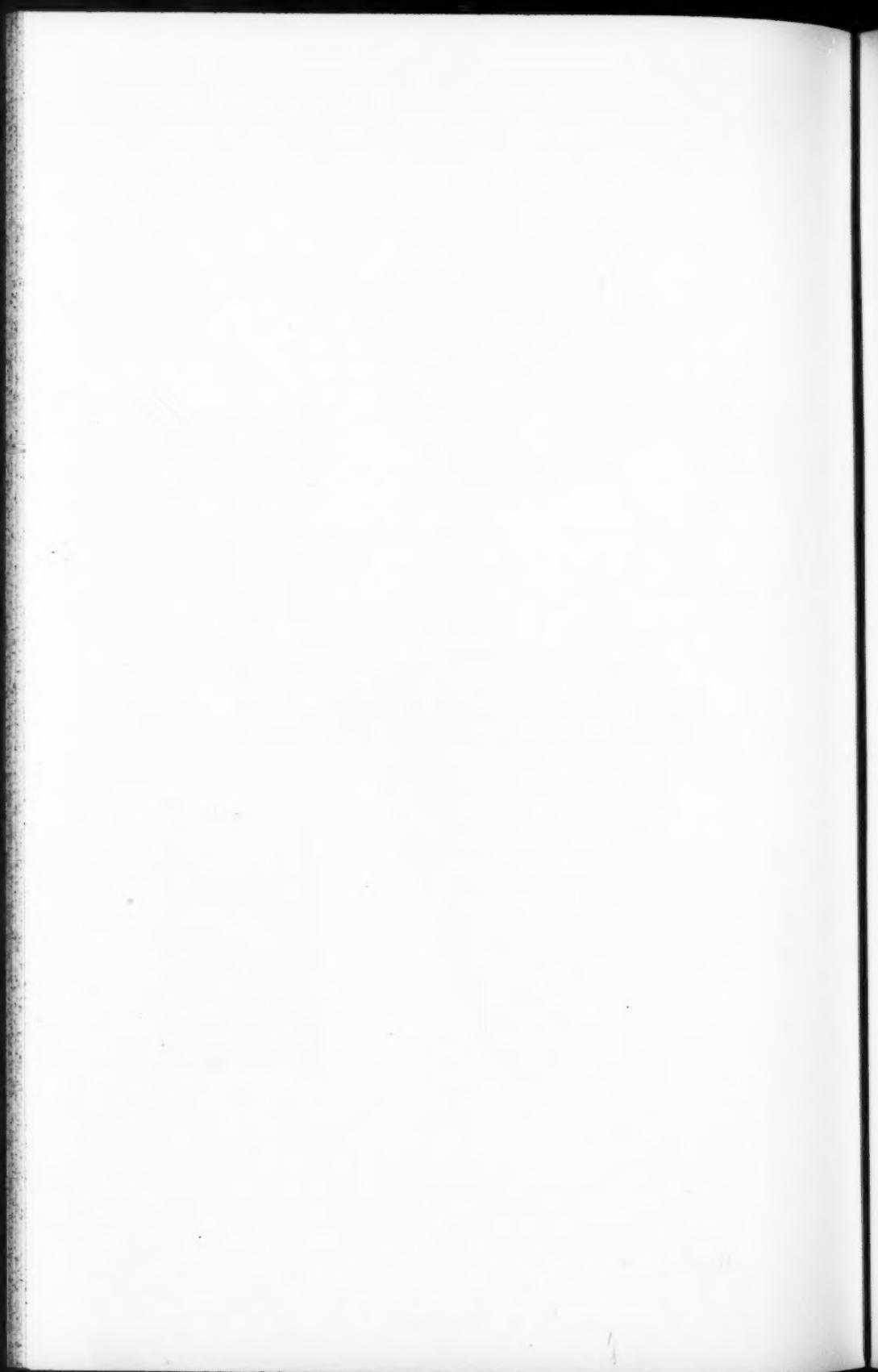
Fig. 3. Diagrammatic cross-section of node of stem of *Apocynum cannabinum*, immediately below foliar gap.

Fig. 4. Diagrammatic longitudinal section of node of stem of *Apocynum cannabinum*.

Fig. 5. Embryo of *Apocynum hypericifolium*. $\times 30$.

Fig. 6. Tracheid from secondary xylem of stem of *Apocynum cannabinum*, illustrating bordered pits. $\times 1000$.





EXPLANATION OF PLATE

PLATE 5

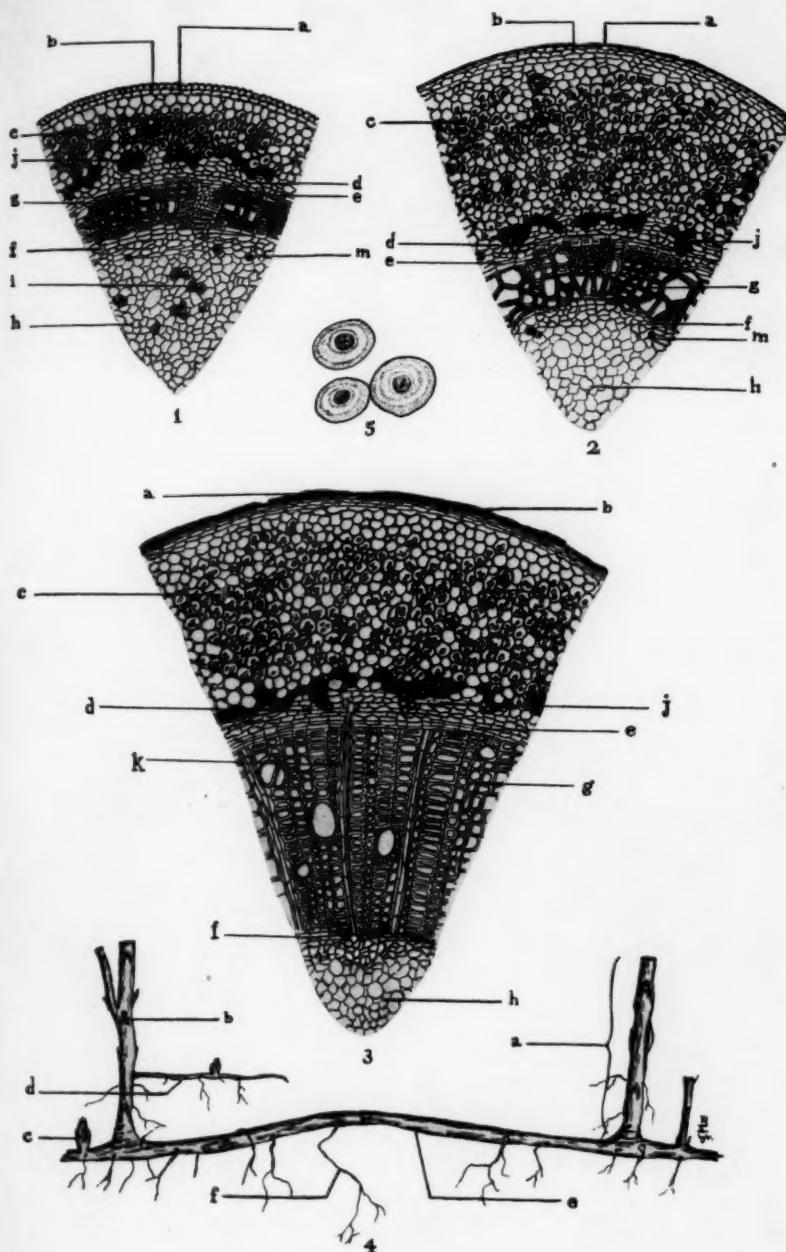
Fig. 1. Sector of a cross-section of a stem of *Apocynum cannabinum*: *a*, epidermis; *b*, hypodermis; *c*, cortex; *d*, external phloem; *e*, cambium; *f*, internal phloem; *g*, xylem; *h*, pith; *i*, starch-containing cells of pith; *j*, pericyclic fibers associated with latex tubes; *m*, latex tubes in pith. $\times 150$.

Fig. 2. Sector of a cross-section of a stem of *Apocynum androsaemifolium*: *a*, dead epidermal cells; *b*, periderm; *c*, cortex; *d*, external phloem; *e*, cambium; *f*, internal phloem; *g*, xylem; *h*, pith; *j*, pericyclic fibers associated with latex tubes; *m*, internal latex tubes. $\times 150$.

Fig. 3. Sector of a cross-section of a fully mature rhizome of *Apocynum cannabinum*: *a*, dead epidermal cells; *b*, periderm; *c*, cortex; *d*, external phloem; *e*, cambium; *f*, internal phloem; *g*, xylem; *h*, pith; *j*, pericyclic fibers associated with latex tubes; *k*, vascular ray. $\times 150$.

Fig. 4. Habit of the subterranean axes of *Apocynum cannabinum*: *a*, rhizome; *b*, cataphylls; *c*, young root-shoot enveloped in cataphylls; *d*, young gemmiferous root bearing a young root-shoot; *e*, fully mature gemmiferous root bearing several rhizomes; *f*, strictly absorptive root. $\times \frac{3}{5}$.

Fig. 5. Starch grains from cortical cells of *Apocynum cannabinum*.



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PLATE 6

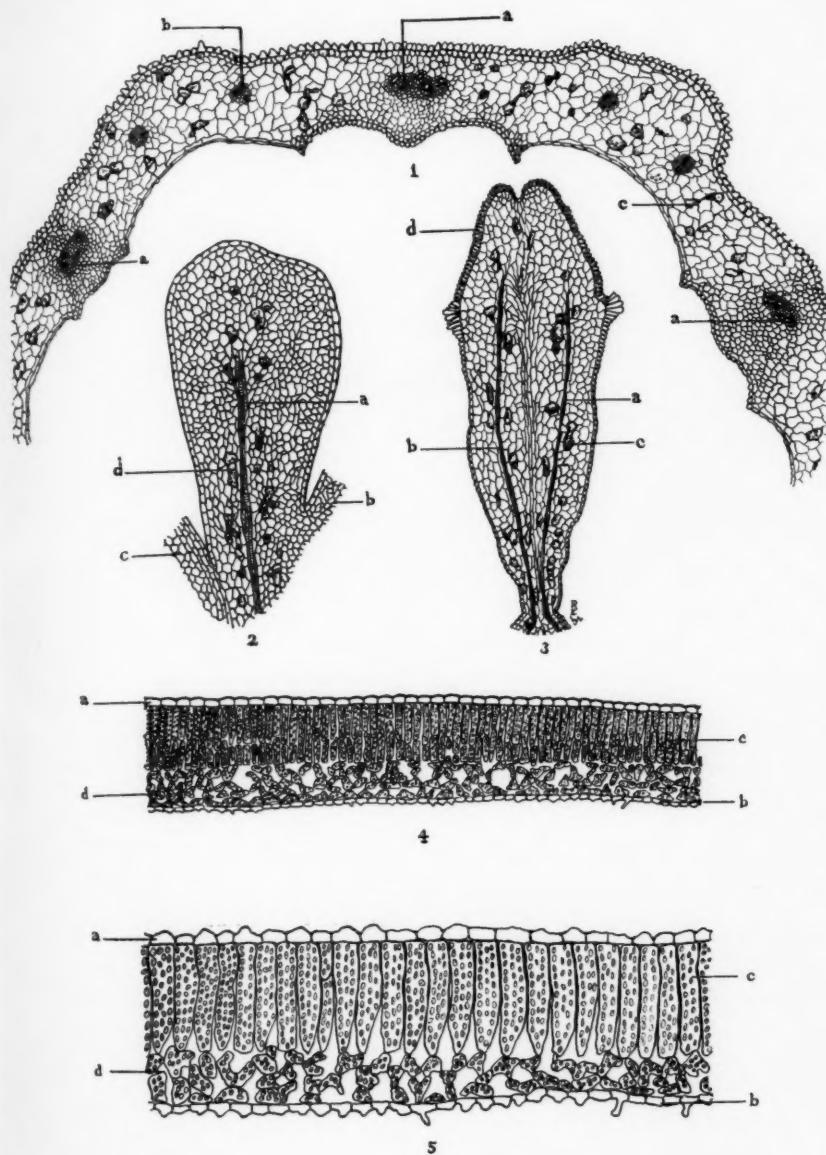
Fig. 1. Sector of a cross-section of the corolla-tube of *Apocynum androsaemifolium* var. *incanum* through the region of the corollar appendages: a, dorsal vascular trace; b, ventral trace; c, latex tubes. $\times 150$.

Fig. 2. Longitudinal section of a nectary of *Apocynum androsaemifolium* var. *incanum*, indicating the vascular anatomy: a, dorsal vascular trace of nectary; b, sector of corolla-tube; c, sector of ovary wall; d, latex tubes. $\times 150$.

Fig. 3. Longitudinal section of the clavuncle of *Apocynum androsaemifolium*, indicating the vascular anatomy: a-b, continuation of the dorsal vascular trace of either carpel of the gynoecium; c, latex tubes; d, glandular cells of the stigmatic surface. $\times 150$.

Fig. 4. Cross-section of a leaf of *Apocynum cannabinum* var. *glaberrimum*: a, upper epidermis; b, lower epidermis; c, palisade parenchyma; d, spongy parenchyma. $\times 100$.

Fig. 5. Cross-section of a leaf of *Apocynum androsaemifolium* var. *incanum*: a, upper epidermis; b, lower epidermis; c, palisade parenchyma; d, spongy parenchyma. $\times 150$.



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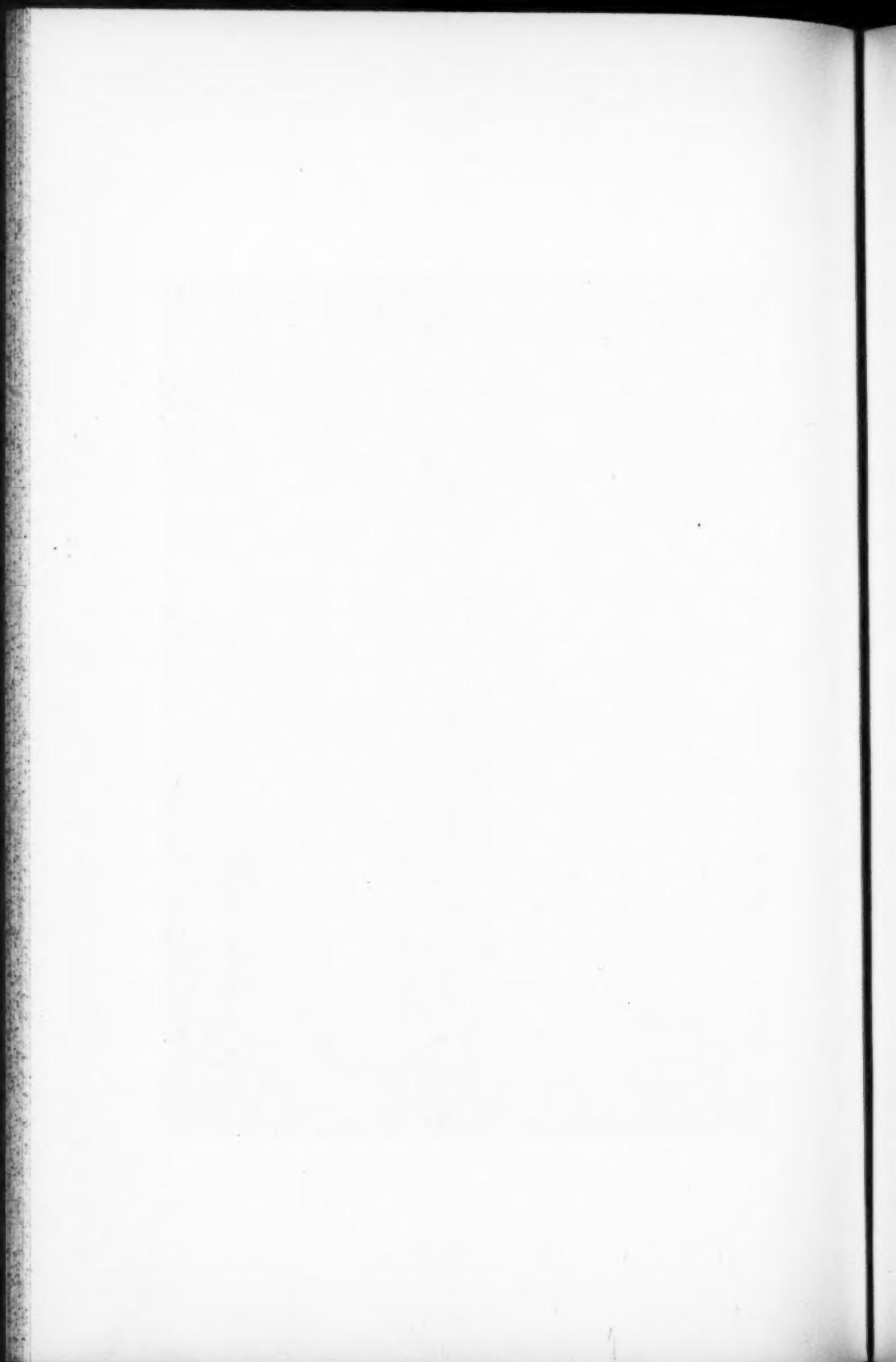
PLATE 7

A typical clone of *Apocynum cannabinum*, near Carondelet, Missouri.



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PLATE 8

Apocynum medium var. *lividum*, infesting cultivated field, near Bayfield, Colorado.



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PLATE 9

Habit of *Apocynum androsaemifolium* L. var. *incanum* A. DC. $\times \frac{1}{2}$;
enlarged flower, $\times 2$.

del. J. A. Steyermark.



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PLATE 10

Habit of *Apocynum pumilum* (A. Gray) Greene var. *rhomboideum* (Greene) Bég. & Bel.
× ½; enlarged flower, × 2.

del. J. A. Steyermark.



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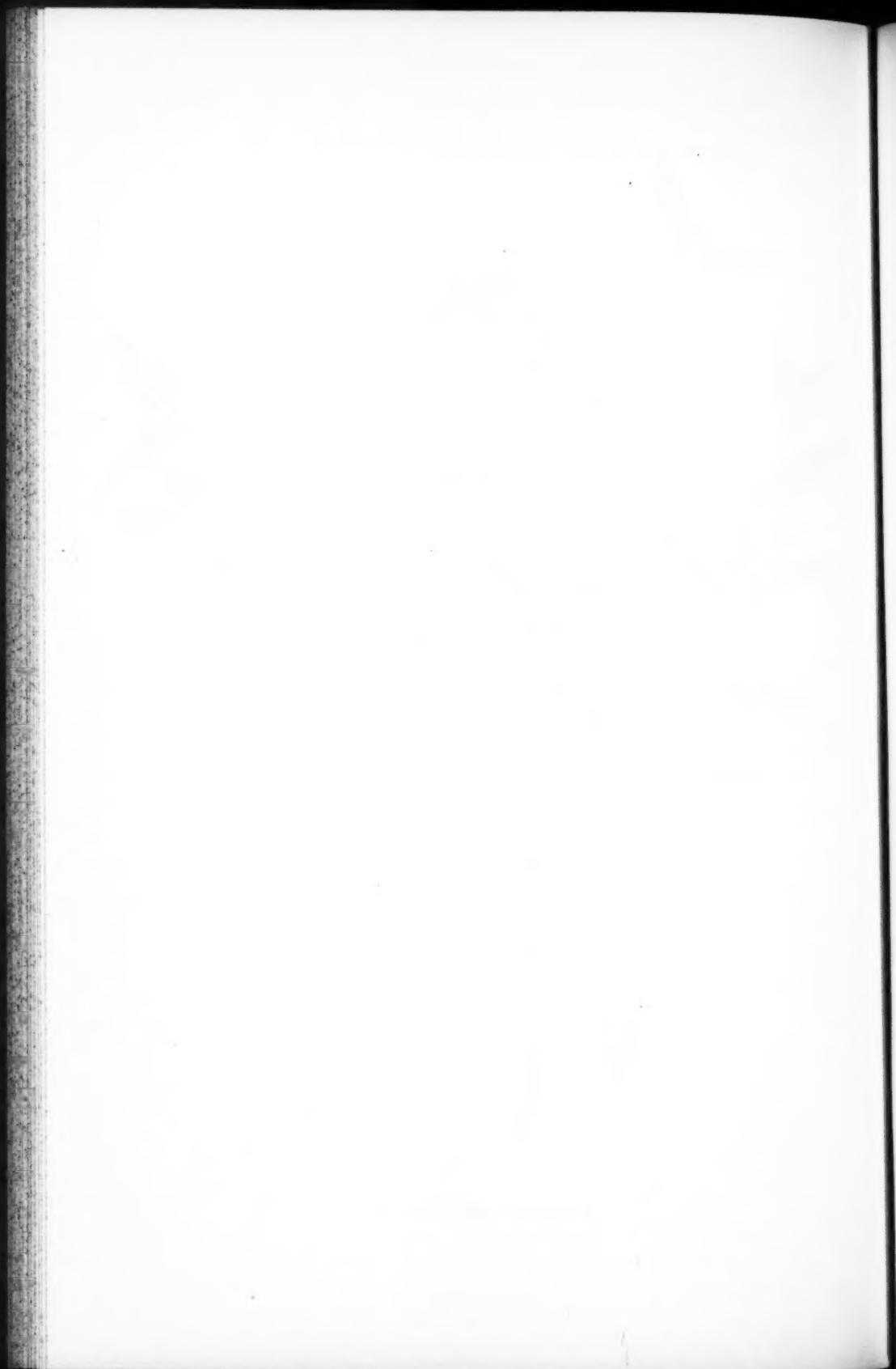
PLATE 11

Habit of *Apocynum medium* Greene, $\times \frac{1}{2}$;
enlarged flower, $\times 2$.

del. J. A. Steyermark.



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PLATE 12

Habit of *Apocynum medium* Greene var. *floribundum* (Greene) Woodson, $\times \frac{1}{2}$;
enlarged flower, $\times 3$.

del. J. A. Steyermark.



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PLATE 13

Habit of *Apocynum medium* Greene var. *vestitum* (Greene) Woodson, $\times \frac{1}{2}$;
enlarged flower, $\times 3$.

del. J. A. Steyermark.



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PLATE 14

Habit of *Apocynum Jonesii* Woodson, $\times \frac{1}{2}$;
enlarged flower, $\times 4$.

del. J. A. Steyermark.



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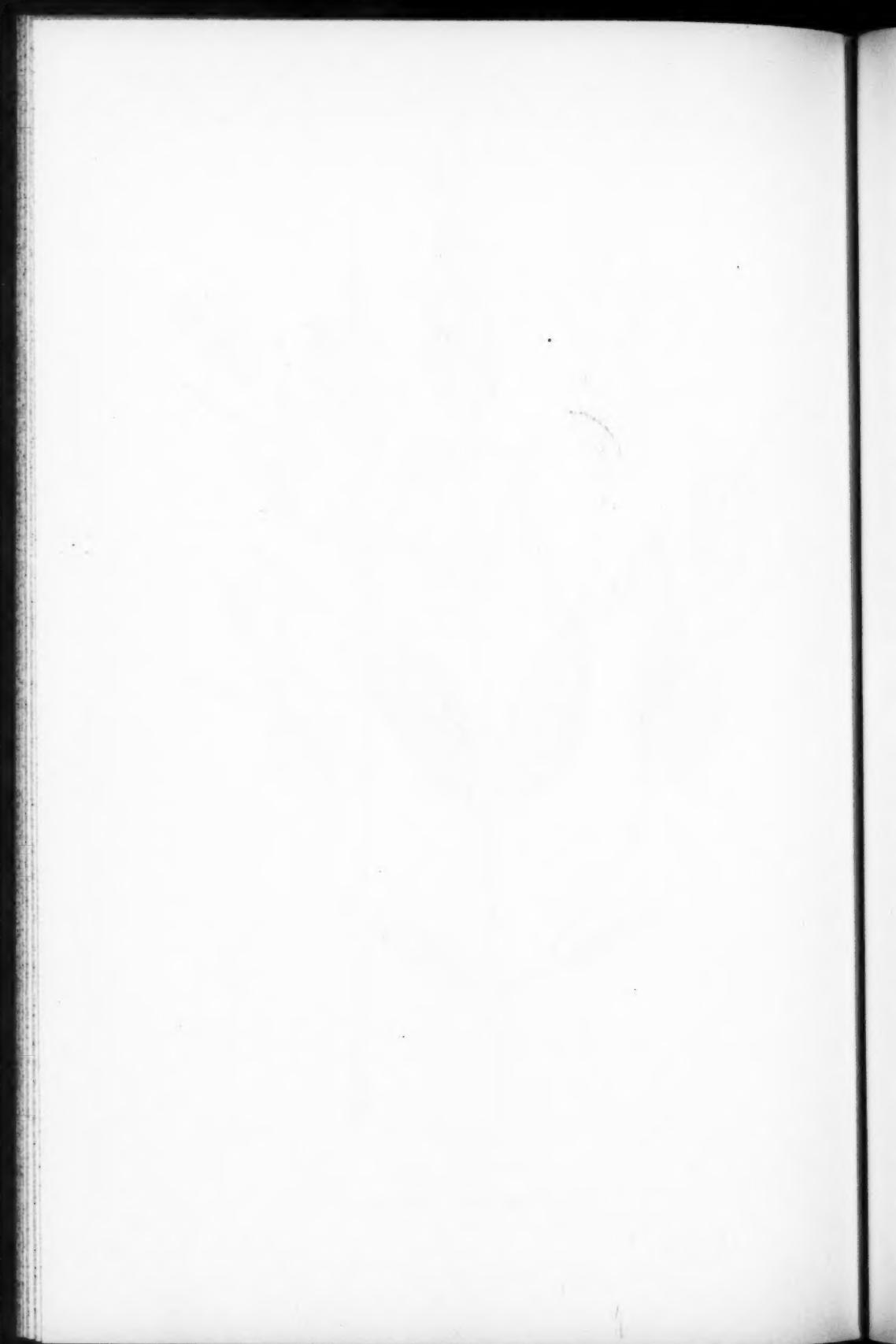
PLATE 15

Habit of *Apocynum Suksdorfii* Greene, $\times \frac{1}{2}$;
enlarged flower, $\times 4$.

del. J. A. Steyermark.



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PLATE 16

Habit of *Apocynum cannabinum* L. $\times \frac{1}{2}$;
enlarged flower, $\times 4$.

del. J. A. Steyermark.



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PLATE 17

Habit of *Apocynum cannabinum* L. var. *Greeneanum* (Bég. & Bel.) Woodson,
 $\times \frac{1}{2}$; enlarged flower, $\times 3$.

del. J. A. Steyermark.



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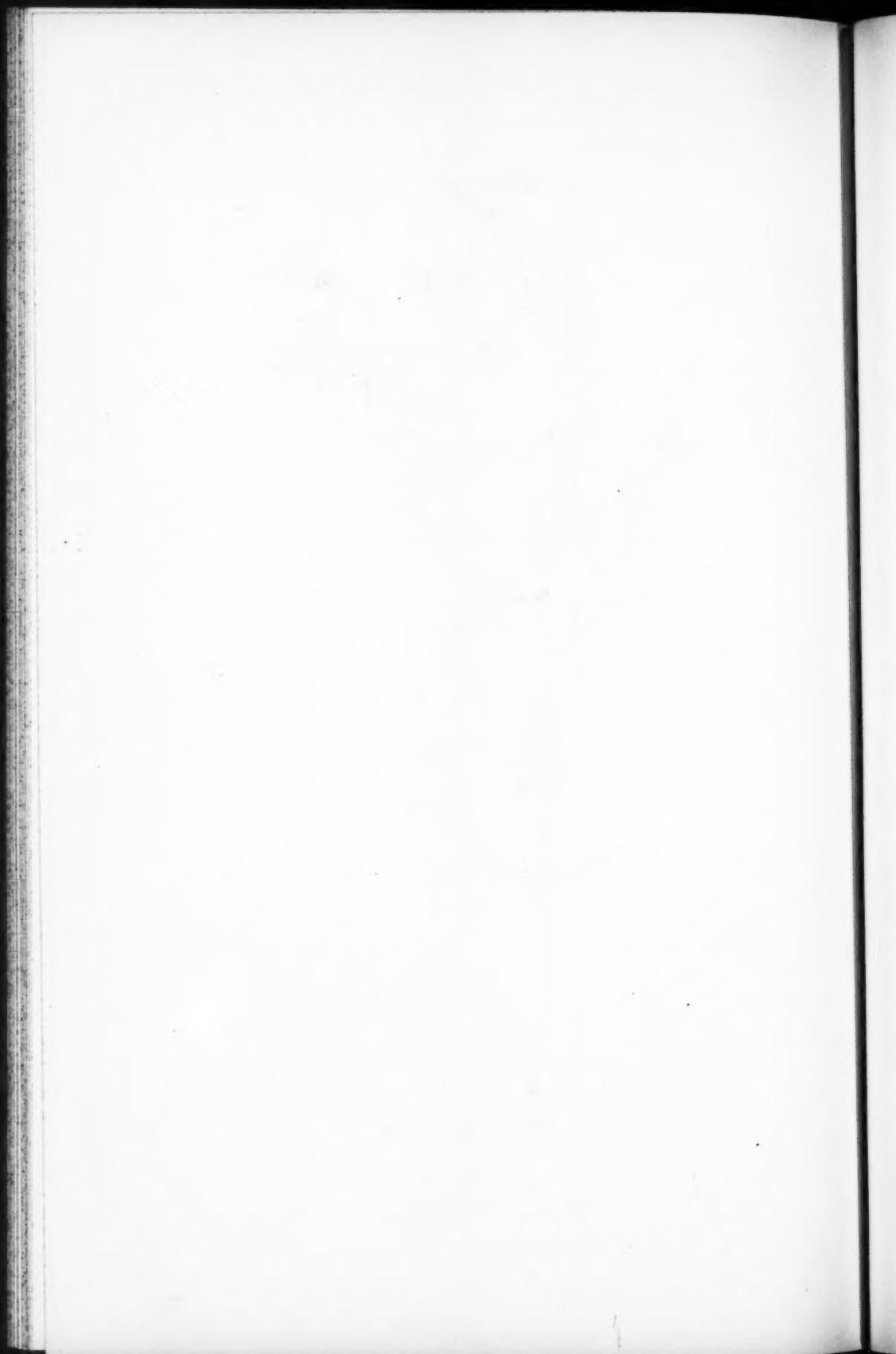
PLATE 18

Habit of *Apocynum hypericifolium* Ait. $\times \frac{1}{2}$;
enlarged flower, $\times 3$.

del. J. A. Steyermark.



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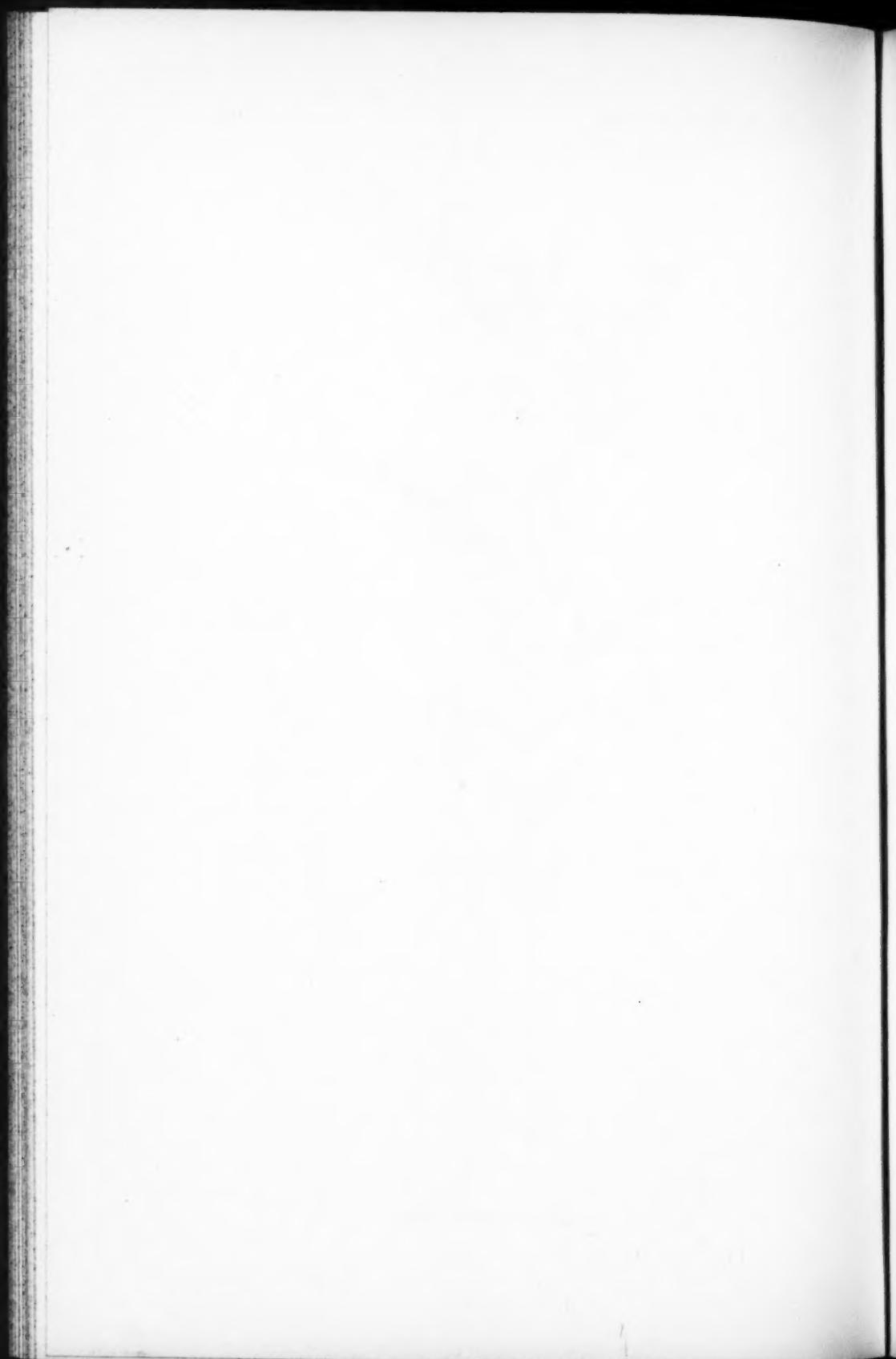
PLATE 19

Habit of *Apocynum hypericifolium* Ait. var. *salignum* (Greene) Woodson, $\times \frac{1}{2}$;
enlarged flower, $\times 3$.

del. J. A. Steyermark.



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PLATE 20

Comparative morphology of *Apocynum*, *Trachomitum*, and *Poacynum*: 1, inflorescence; 2, exterior of flower; 3, interior of corolla, indicating the corollar appendages; 4, rear of stamen, illustrating the auriculate anther; 5, gynoecium, illustrating the clavuncle, carpels, and nectaries.

